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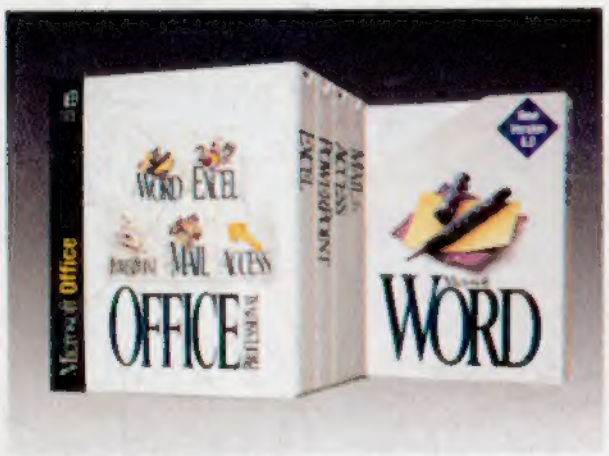

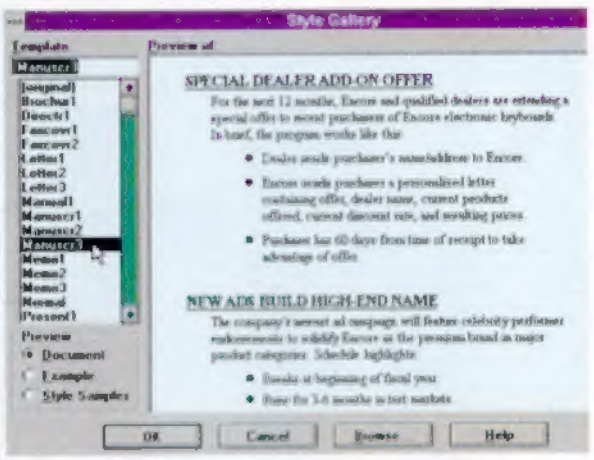

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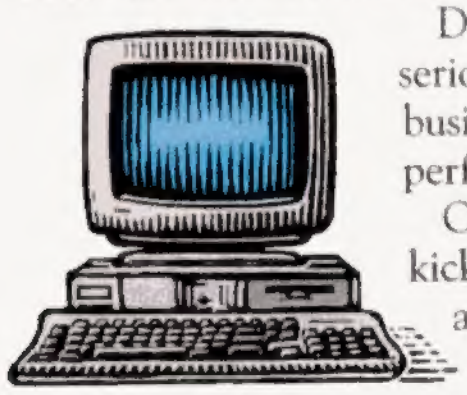

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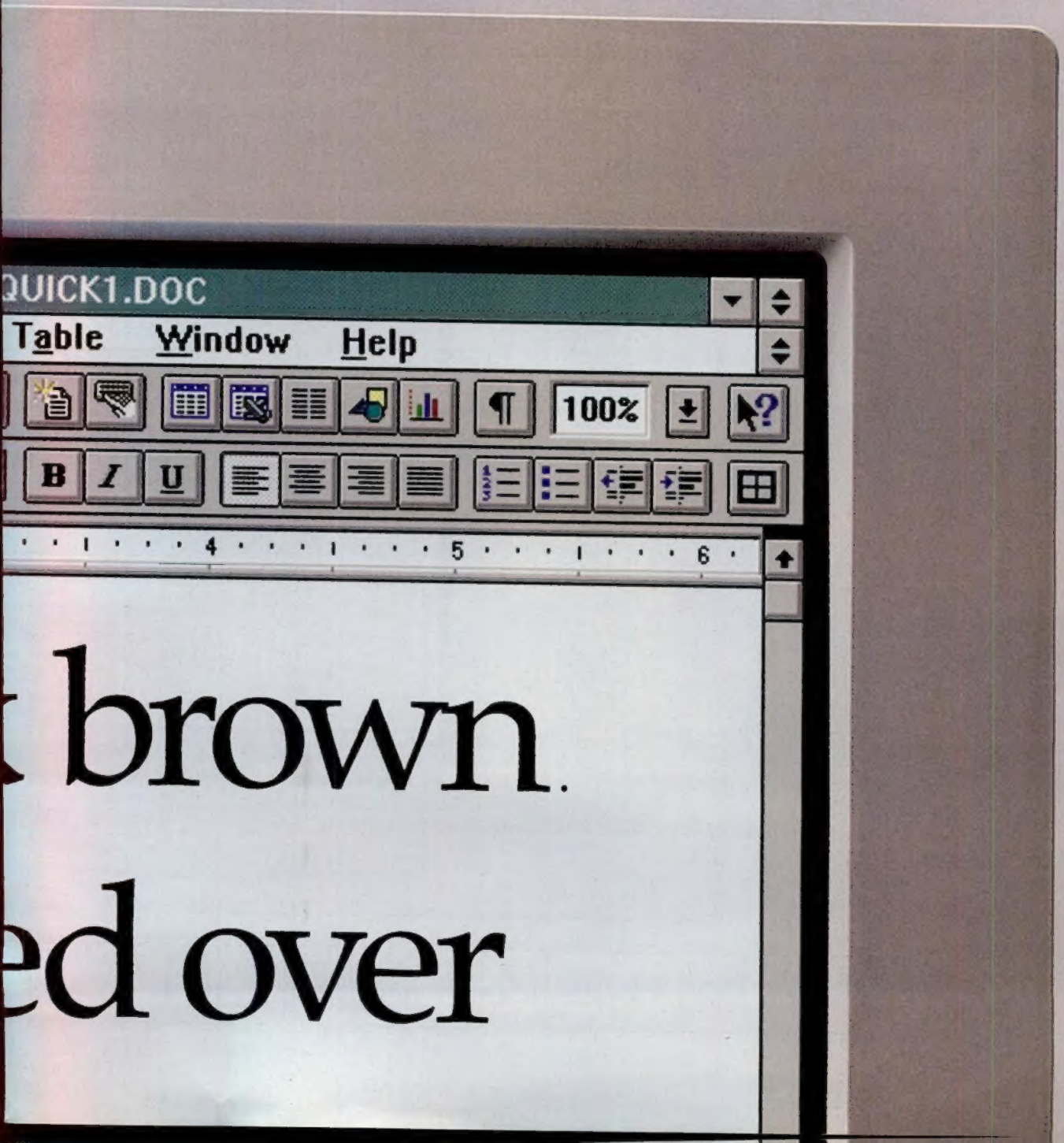
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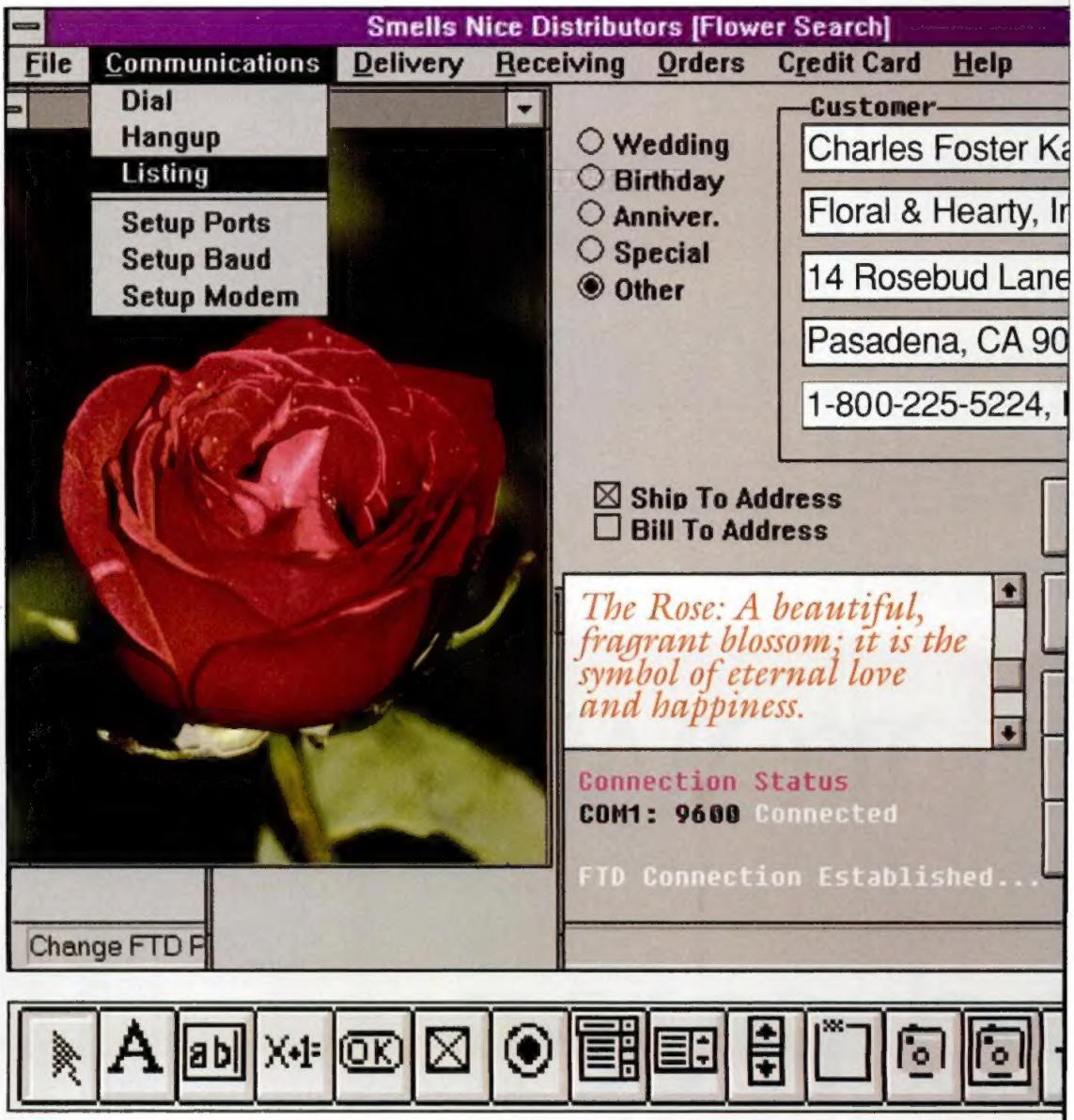

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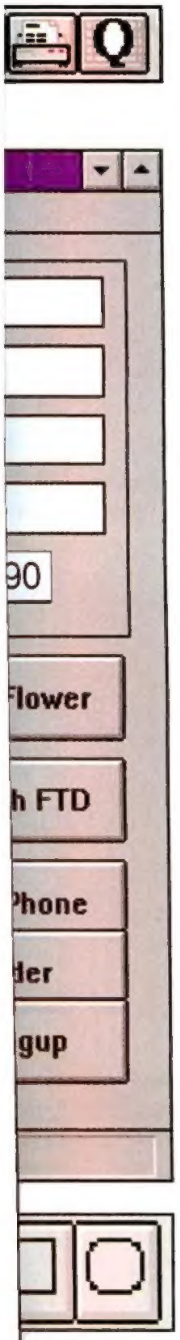

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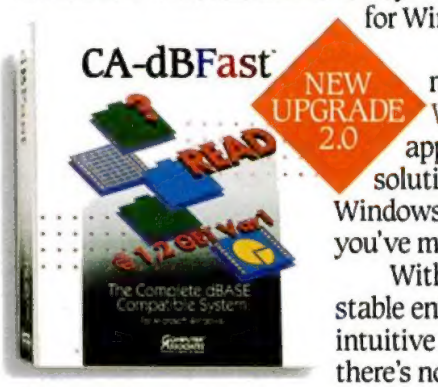

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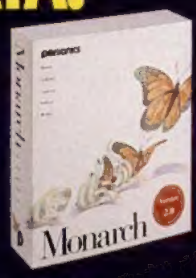

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Inside

Remember that old phone company commercial proclaiming that "we're all connected"? Chances are that unless you're connected, you're not computing. Already, more than half our *PC Magazine* readers plug into a network. Increasingly, no application is worth the cost of the packaging unless it has some "connectivity" feature: work flow, e-mail, or shared data.

The team in charge of networking and communications at *PC Magazine* has the daunting task of testing and evaluating some of the most complex products in the PC arena. Its domain includes routers, hubs, protocol analyzers, and LAN adapters. It also covers communications, backup software, and sundry other products.

This issue gives you an opportunity to know our team members better. "Playing the Odds" is their exposition of the state of the art in network operating systems. Our coverage is led by senior editor David Greenfield and senior networking editor Frank J. Derfler, Jr. Gail Shaffer, a former executive editor at *PC Week*, is associate editor for network features, working closely with Rich Brady, a PC Labs project leader, on our torture tests for contending products. Our networking crew also includes Andrew Kantor, a staff editor, and Adam Hicks, an editorial researcher.

Unless you get the Network Edition of *PC Magazine*, you'll rarely see the names of Mike Ryan or Vicki Jacobson, two of our staff editors; Robert Lipschutz, a project leader; or Jeff Baher, a tech analyst. The Network Edition is a special section sent to some 300,000 *PC Magazine* subscribers with a keen interest in networking products. So if you want to improve your connections, call 800-289-0429 and connect to the Network Edition.—*Joel Dreyfuss*

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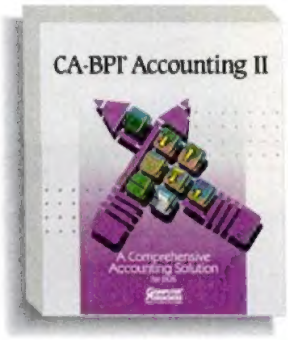

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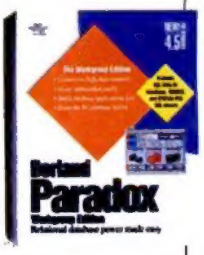

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The Price Waterhouse Report: LAN-Based Accounting at the Crossroads

BY TED STEVENSON AND TOM WHITE It's not a question any more: LAN-based accounting packages *can* compete with minicomputer applications. Certainly this is true in terms of performance. And with the latest generation, the features gap is closing, too. The highest flyers among our 11 multimodule accounting packages offer such sophisticated functions as multicompany consolidations, multicurrency transactions, and almost limitless customizability. Move over, minis! 223

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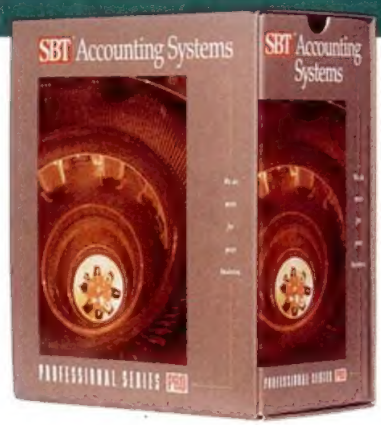

PC accounting packages are invading mini-computer market territory (page 223).

Networking

Network Operating Systems: Playing the Odds

BY GARY GUNNERSON You must choose your game well as you decide on a network operating system. Assessing your software requirements as related to current and future connectivity needs is never more important than when you commit to a NOS. We review the odds for success—as well as the learning-curve and dollar antes—on a range of multiserver NOS solutions. Some offer mainly stellar file and print service; some, broad protocol support; some, symmetrical multiprocessor support out of the box. In the NOS casino, you have to know what you want; then you're more likely to get what you need 285

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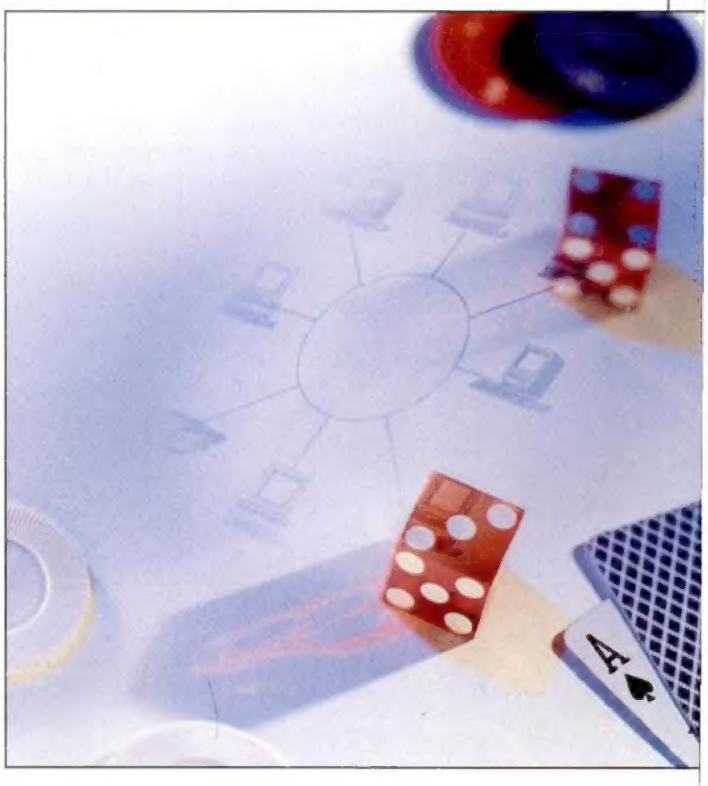

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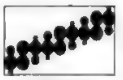
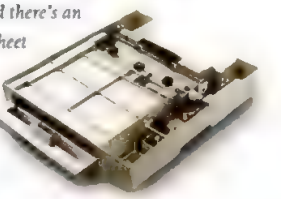

with RITech

without RITech

Epson's RITech (Resolution Improvement Technology) increases the ActionLaser's normal 300 dpi print quality to eliminate jagged edges right where you need it: in the curved lines of letters, numbers and images. And Epson's MicroArt Printing technology gives you blacker blacks and finer lines.

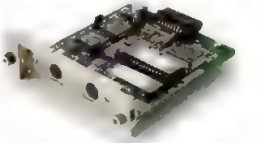
27 fonts (13 scalable) are standard. Should you expand your typographical horizons, unlimited fonts are easy to install via HP-compatible plug-in cartridges, available anywhere.

The ActionLaser has 150 sheet paper capacity (letter or legal), and handles stacks of labels, envelopes and overheads with ease. And there's an optional 250 sheet auto-feed cassette, for a total of 400 sheets.

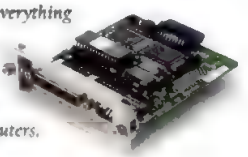


The ActionLaser 1500's top speed is six ppm, fifty percent faster than others in the same price range. That's fast.

If you have a DOS machine, but decide to get a Macintosh, do you need a new printer? Not with an ActionLaser 1500. Just add our EpsonTalk interface and your Mac plugs right in.



The ActionLaser 1500 comes standard with parallel and serial interfaces that allow two users to share a single printer. Add another interface and a third user can share the same printer. The ActionLaser 1500 can connect to everything from PCs to IBM mini and mainframe computers.



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a shining example of the power the Windows interface has to make a complex activity easy to learn and productive to use. There aren't many h

—*Computer Technology Review*

ease of use starts with the "Friendly Accountant" (a little guy in a green eyeshade!) that walks users through setup and installation, and Smart Guides that help explain data fields and eases users into the program and accounting in general.

—*Computer Technology Review*

A dramatic new interface, new help functions and, more flexible, powerful money management functions make it hard to beat for small business accounting.

— *PC Magazine*

product I've seen. The program's new look incorporates state-of-the-art Windows conventions: descriptive icons, real-life representations of graphic forms, and visual flow charts that guide you through an accounting process.

—*Home Office Computing*

Accounting software developers have tried to do the impossible for years; wrap an intuitive simple, flexible interface and feature set around the rigid, cumbersome, complex process of double-entry bookkeeping. Peachtree Software's recently unveiled Release 2 of Peachtree Accounting for Windows ($169) succeeds. Even when you consider its for

— *PC Magazine*

PAW offers General Ledger, Accounts Receivable, Accounts Payable, Payroll, Inventory, Job/Project Tracking, Financial Report Writer, Custom Forms Design, Bank Reconciliation and Import/ Export. With its use of the MDI (multiple document interface) specifications, any and all of these modules can be open at once, each automatically updated as changes are made in any other. The program

—*Computer Technology Review*

succeeds. Even when you consider its formidable competition, Peachtree's new cash management functions, ease-of-use features, and flexibility move the product ahead of the pack.

— *PC Magazine*

the program now uses less accounting jargon than the previous version—a real boon for the typical small business person. Other standout features well-int

—*Compute*

more intuitive and full featured than any similar product I've seen. The program's new look incorpo

—*Compute*

The best-selling Windows accounting software.

—*As Reported in PC Week.*

And it's multiuser straight out of the box.

—*PC Magazine*

For a small business that's ready to upgrade from a checkbook program, Peachtree Accounting definitely deserves a close look. ■

—*Windows Magazine*

Enough Said.

To order for only $169, call (800) 428-9973. Or see your local dealer.

Peachtree Accounting For Windows, Release 2.0

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"PLEASE GIVE ME A BUILT-IN SPREADSHEET." With nearly 100 spreadsheet functions, WordPerfect now lets you crunch numbers right within the program. Or you can easily import spreadsheets as usual.

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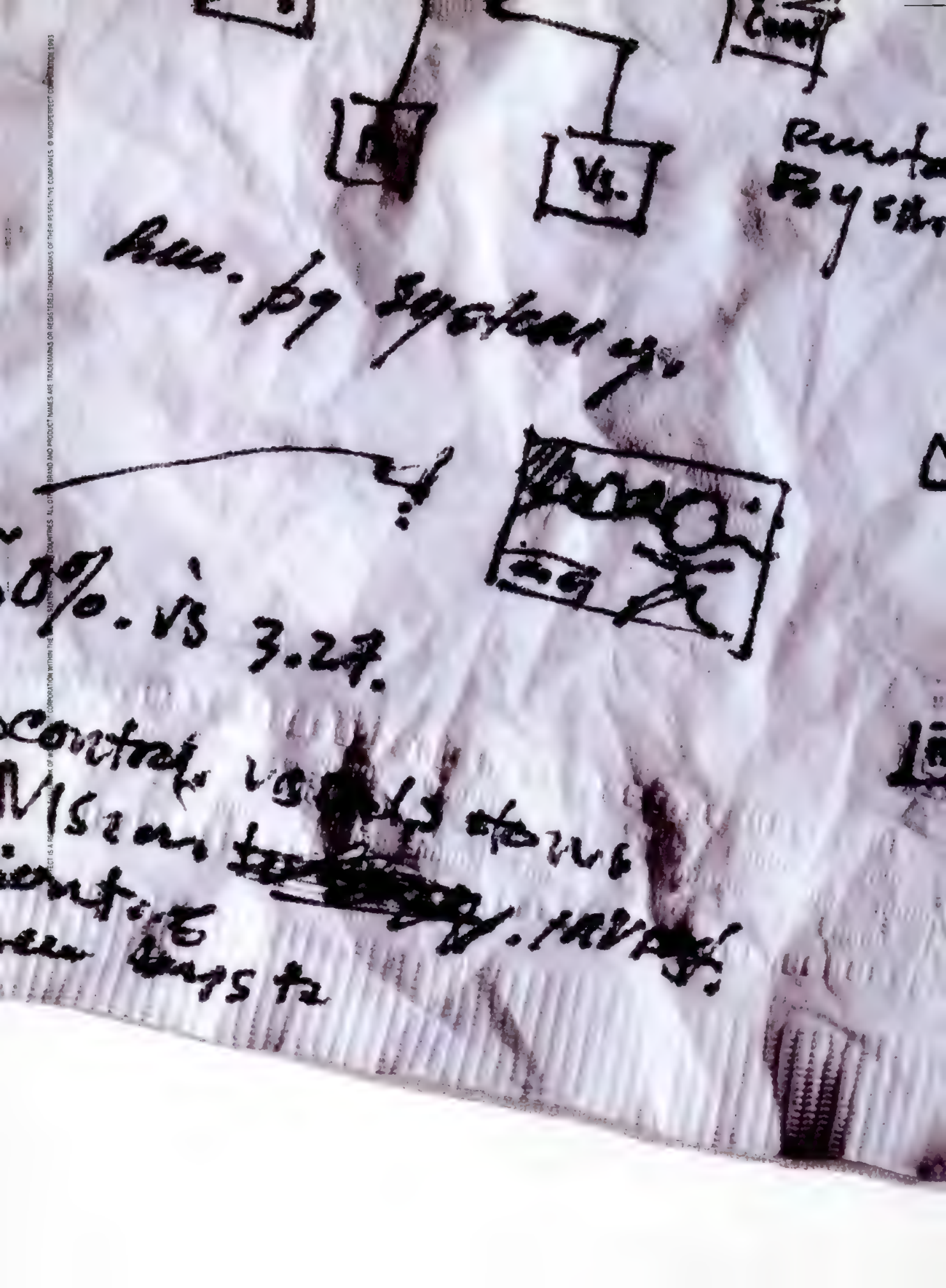

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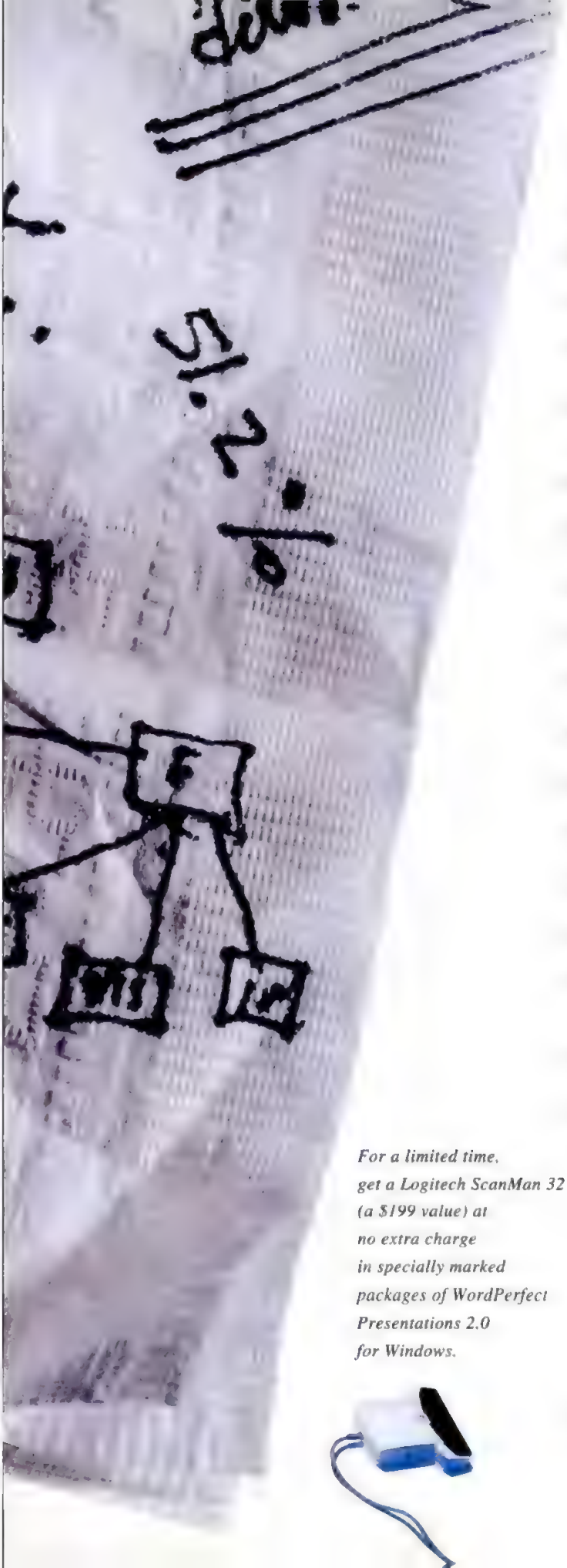

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The same can be said of our economical 14" color monitor (SC-428TXL). Both are VGA and VESA compatible.

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SC-528DXL (15")

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Letters

MS-DOS VERSUS THE WORLD

Thanks for your terrific September 14, 1993 cover story "The Best Utilities: How Does DOS 6 Stack Up?" This is the very question I've been hoping someone would answer. For a few months now I've felt like an outcast because I haven't upgraded to MS-DOS 6.0. Nothing against Microsoft, but I'm a bit reluctant to toss aside my favorite standalone utilities without a good reason. Although we may disagree on which utilities are the best, I'm grateful that you took the time to confirm my suspicion: MS-DOS 6.0 isn't packing anything that will make my current configuration better. Now I can feel comfortable in my decision to stick with MS-DOS 5.0.

Terry G. Wiseman
New York, New York

I'm bewildered by your Editors' Choice for Stacker 3.1 in the September 14 "Best Utilities" review. I'd been using DoubleSpace without problems, but felt the cost of Stacker outweighed the risks of DoubleSpace. In only three days of using Stacker, I've encountered countless freeze-ups, garbage on the screen, memory errors, and difficulties reaching Stac technical support. I'm going back to DoubleSpace. Bill Gates, I'm sorry for doubting you.

Jeff Fried
Chester Springs, Pennsylvania

You're right, Stacker is truly the best disk compression product. One word of advice to all those using DoubleSpace who want to convert to Stacker: Convert your compressed drive to Stacker format soon after you install Stacker's device driver. This way you'll avoid potential problems down the road.

Eric W. Norst
Toronto, Ontario, Canada

READERS' BEST UTILITIES

One question on your September 14 review of the best utilities: What do you mean, no Editors' Choice for backup and restore utilities? Central Point Backup for DOS and for Windows are the best

I've felt like an outcast because I haven't upgraded to MS-DOS 6.0.

utilities out there. They back up to everything—including certain SCSI tape drives. You advise me to use the backup software that comes with a tape backup system, but how good is that software? Personally, I don't use a tape backup system (I usually just back up data files and other important files onto a couple of floppy disks). My advice is, go for the best! If you need more reasons to have a great utility like Central Point Backup, look into getting Central Point's PC Tools. That way, you get the backup software that's *really* the best, plus a lot more.

B.H. Winkler
Chicago, Illinois

Your review of Fifth Generation Systems' Fastback Plus in the September 14 "Best Utilities" feature does not coincide with my experiences. I've found Fastback Plus to be an exceptional utility for years. I've used Fastback Plus for DOS and for Windows on several SCSI-based systems, backing up from one hard disk to another and to floppy disks without a single hitch.

Jim Ogg
Stow, Massachusetts

Thanks for the September 14 coverage of MS-DOS utilities. You missed a very significant option to third-party memory managers, multiple boot managers, and disk caches, however. . .OS/2 2.1!.

Ramer W. Streed
North Mankato, Minnesota

FIDDLING WHILE RAM BURNS

The September 14 Trends article, "DRAM Drought," explores most of the reasons for the scarcity of DRAM except one: the major explosion in the Sumitomo Chemical plant in Japan at the end of June. Sumitomo Chemical made over half of the world's supply of the epoxy resin used in chip (mainly memory chip) manufacturing.

You also point out that American companies got out of the DRAM business in the early 1980s, which makes me wonder what other areas of computer manufacturing are in a situation where critical components are cornered by a few manufacturers.

Jonathan Lackman
Kansas City, Kansas

Recently I bought a machine with 2MB of RAM and then realized that it wasn't enough. Suddenly a factory on the other side of the world burns down, and now the price of RAM is twice what it was. I'm familiar with supply and demand, but everyone I called had an ample supply—just at twice the price. I'm also familiar with price gouging, consumer fraud, and userism.

Ron Perino
Albuquerque, New Mexico

THE DEMISE OF SERENDIPITY?

In "The Daily Me" (Trends, September 14) you seem to praise tomorrow's electronic news delivery systems for being able to bring us stories about topics that interest us. But if tomorrow's electronic news limits people to subjects in which they're already interested, how can they ever become interested in anything new? We'll end up with a lot of people who know a lot about not very much. Is this the demise of serendipty?

Frank Shallenberger
Cupertino, California

You just saved a bundle on PCs. Now, who's going to save you from the people who have to use them?

Low price alone doesn't equal value. A PC that can't do what you need is a PC you just can't afford. Fortunately, AST's Bravo family now includes everything from notebooks to minitowers. All packed with features and power. Consider the low-profile Bravo LP, a powerful yet energy-efficient desktop with EPA EnergyStar approval. Also EPA-approved is the Bravo MT, an upgradable, enormously expandable minitower. To get excellent Windows performance at a low price, check out the Bravo LC with local bus graphics. And the Bravo NB gives you a powerful, advanced notebook you can actually afford. So before you choose, call us at 800-876-4AST. Your controller will like the price. Everyone else will like the computers.

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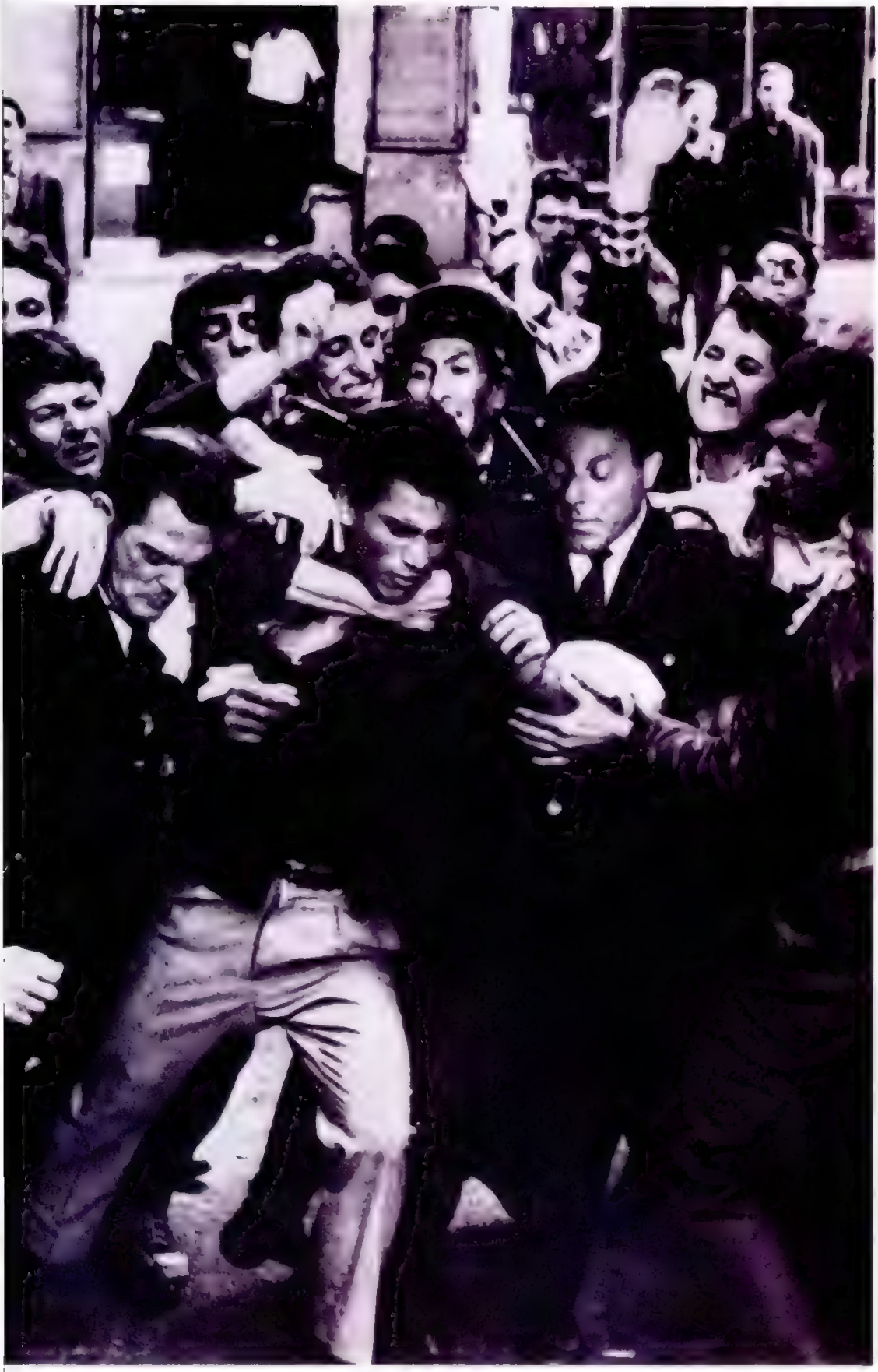

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LETTERS

APOLOGIES TO ROBERT FROST

Shame on Executive Editor Robin Raskin for blowing an opportunity to show the world that we computer geeks can also be literate. In her September 14 Pipeline column, Ms. Raskin goofed when quoting American poet Robert Frost. Yes, he did write about two roads diverging, and yes, he wrote about stopping in snowy woods, but not in the same poem.

Judy G. Russell
Avenel, New Jersey

Luckily for us readers, Robin Raskin's superior knowledge of the business of modern PC technology far outstrips her knowledge of American poets.

Patt Bruzza
San Ramon, California

• **Robin Raskin wishes that she could personally thank the readers who wrote in to point out her misquote of Frost's poem, "The Road Not Taken." Unfortunately, she has promises to keep and miles to go before she sleeps.—Ed.**

NOW AVAILABLE NEAR YOU

I found your September 14 Trends article, "VESA Goes Green," informative but only partially correct in reference to the IBM monitor family. You state that "IBM Personal Computer Co.'s new PS/2 E system will include a 14-inch DPMS-compatible monitor." Just to clarify, the PS/2 E and the 14-inch VESA DPMS monitor are now available. In addition, IBM has announced and made available four VESA DPMS monitors: the 14V, 15V, 14P, and 15P, which were introduced on July 29.

Jeffery Ullman
PS/2 Marketing Specialist
Coral Gables, Florida

GETTING USED TO WORDPERFECT 6.0

I usually read *PC Magazine* cover to cover, but I had to stop at the Letters section of the September 14 issue to respond to Jack Allen's letter regarding WordPerfect 6.0. I think WordPerfect 6.0 is a wonderful upgrade to a powerful product. It can be a bit disconcerting to an upgrader to get used to a new interface, but within an hour or two it should become second nature. So give 6.0 another try. It's worth it.

Alan Zeth Fromm
Plainview, New York

I feel compelled to respond to Jack Allen's letter in the September 14 issue concerning the radical change from WordPerfect 5.1 to WordPerfect 6.0. Six weeks ago, when I first received my upgrade package, I would have written a similar letter. But after a lot of effort on my part, as well as some successful and some futile help from the renown WordPerfect support staff, I'm glad I converted to version 6.0. Yes, 6.0 is radically different, but once you learn the changes, there's no returning to the past.

Richard L. Butler
Austin, Texas

WordPerfect 6.0 is a wonderful upgrade to a powerful product. It can be disconcerting to get used to a new interface, but within an hour or two it should become second nature.

THE HORROR

Thanks a bunch for the neat picture of the Chinese snake performer pulling snakes through his nose (Abort, Retry, Fail?, September 14). Perhaps we can anticipate still more photos, like emergency room trauma cases, slaughterhouse candid shots, or at the very least, road-kill close-ups.

Rick Deans
Phoenix, Arizona

USER-TO-USER-TO-USER

In the September 14 User-to-User section, Raymond Connelly suggests a way of replacing the nonsystem disk error message. What he doesn't consider is that boot sector viruses on those nonsystem disks will attach to your hard disk when you insert a new disk and press a key. What your new message should say is "Remove floppy disk and press Ctrl-Alt-Del." It's a reminder of the best way to reboot after attempting to boot with a nonsystem floppy disk.

Jim Millard
Kansas City, Missouri

LOOKING TO THE STARS

I was disappointed to find that your July 1993 After Hours roundup, "Stargazers' Delight: Six Programs for Astronomy Hobbyists and Pros," didn't include the popular SkyGlobe 3.5. It's shareware (one of ZiffNet's most popular programs), so it's well worth the low price of registration. It certainly deserves honorable mention, if not accolades!

John Mann
Amherstburg, Ontario, Canada

CORRECTIONS AND AMPLIFICATIONS

In our September 14, 1993 review, "RAID to the Rescue," we printed an incorrect phone number for Storage Solutions, makers of the SSI RACa-ray 5000 CM-01. The correct number is 203-325-0035.

In our July 1993 "Perfect PC" story we failed to acknowledge American Megatrends Inc. (AMI) as a major motherboard manufacturer. In fact, PC Magazine Labs used a number of AMI's EISA- and ISA-based Enterprise III 486DX2 boards with VESA local bus for testing multiple PC configurations and PC components. AMI was among the first manufacturers to ship EISA/VESA motherboards.

HOW TO WRITE TO PC MAGAZINE

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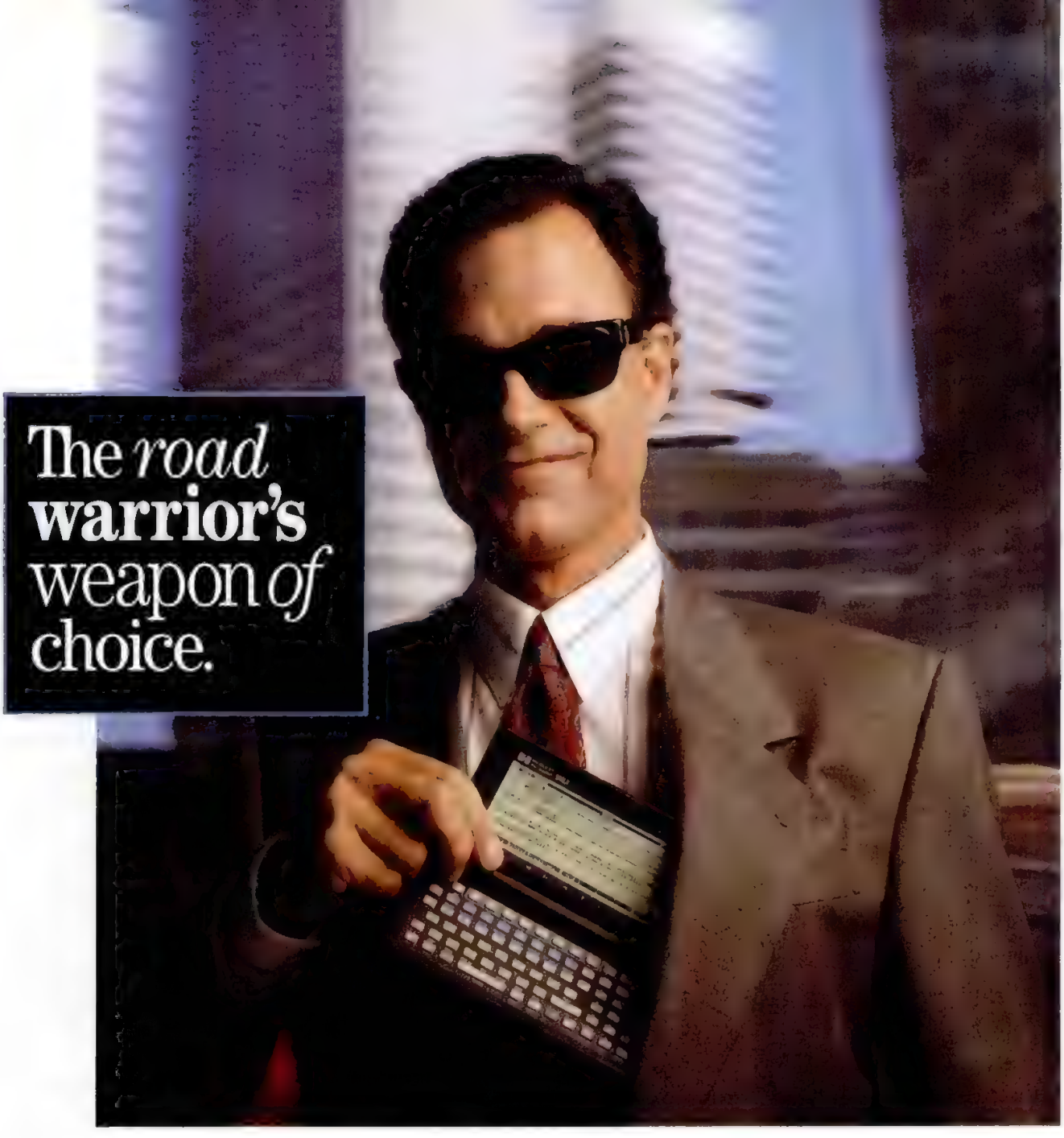

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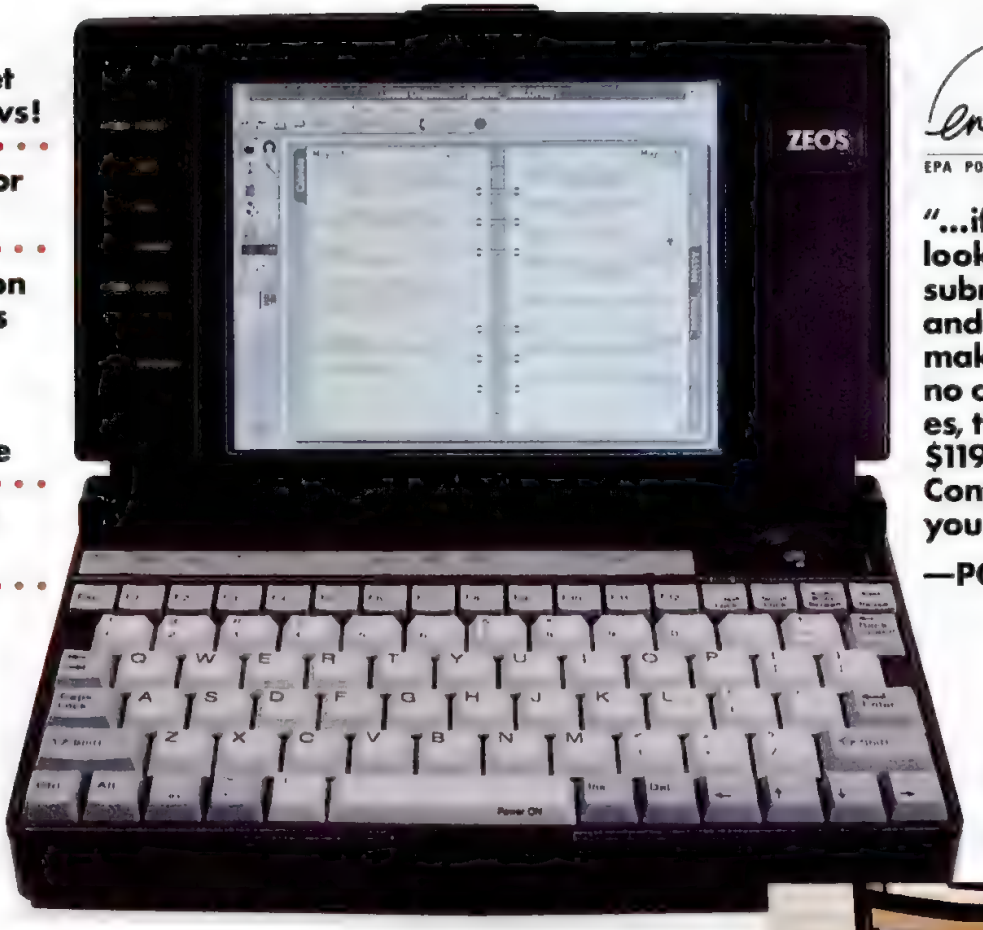

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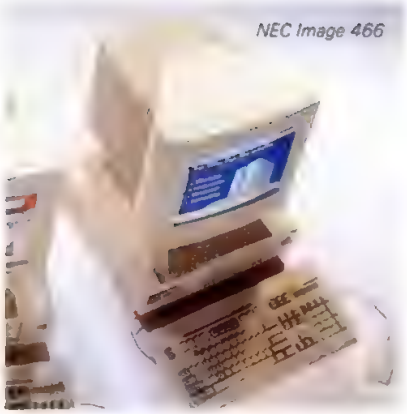

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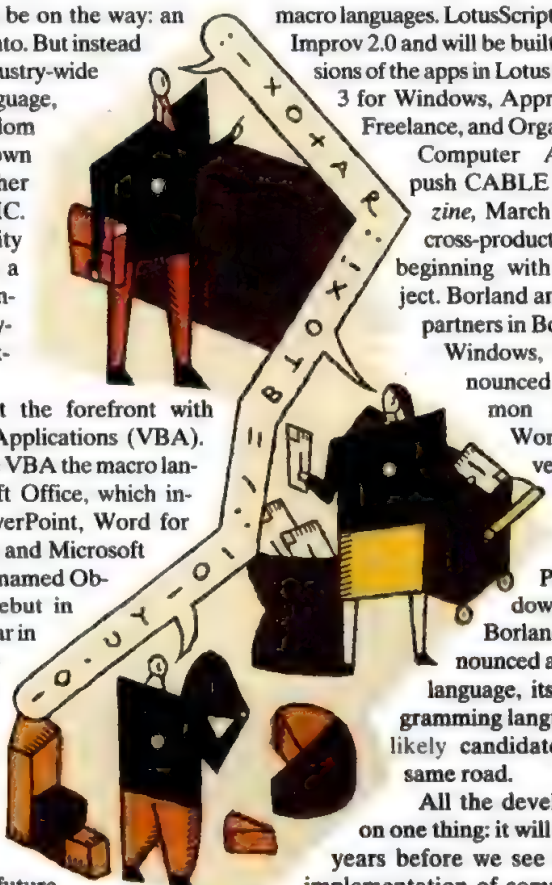
CIRCLE 186 ON READER SERVICE CARD

Application Esperanto

Developers launch common macro dialects.

For several years Microsoft has been promising a common macro language, one that replaces application-specific macro languages and works with all your programs. Until this happens, macro languages continue to proliferate, which means you've got to learn a different one for each application you use. And even then, the programs can't communicate with each other.

A solution may be on the way: an application Esperanto. But instead of promoting an industry-wide common macro language, each software fiefdom is promoting its own dialect of the mother tongue: BASIC. Given the popularity of software suites, a common macro language may lock buyers into a single software vendor.



Microsoft is at the forefront with Visual Basic for Applications (VBA). The goal is to make VBA the macro language of Microsoft Office, which includes Excel, PowerPoint, Word for Windows, Access, and Microsoft Mail. VBA (code-named Object Basic) will debut in Excel 5.0 and appear in Project for Windows later this year. Tightly coupled with Object Linking and Embedding (OLE) 2.0, VBA will work across platforms and run in future Macintosh versions of Excel and Word, according to Microsoft.

Lotus and Computer Associates also plan to use versions of BASIC as their application macro languages. LotusScript was first used in Improv 2.0 and will be built into future versions of the apps in Lotus SmartSuite: 1-2-3 for Windows, Approach, Ami Pro, Freelance, and Organizer.

Computer Associates will push CABLE (see *PC Magazine*, March 30, 1993) as its cross-product macro language beginning with CA-SuperProject. Borland and WordPerfect, partners in Borland Office for Windows, have not announced plans for a common language, but WordPerfect is developing one for its Windows apps that will appear in WordPerfect for Windows 6.0. While Borland has not announced a common macro language, its legacy in programming languages makes it a likely candidate to travel the same road.

All the developers do agree on one thing: it will be several more years before we see the widespread implementation of common macro languages.—*Christopher Barr*

Illustration by Philippe Weisbecker

Roll'em on CD-ROM

PCs WITH CD-ROM DRIVES (THIS issue's cover story) will be the perfect place to play real-time movies. The technology that enables CD-ROM movies—a compression standard called MPEG (short for Motion Picture Experts Group)—is showing up in inexpensive boards. The bad news is that there are few MPEG-compatible applications around that take advantage of the technology.

The MPEG-1 standard was developed specifically for CD-ROMs. With MPEG encoding, a video signal is compressed so it can be played from a single-speed CD-ROM disk and still have the quality of a VHS tape. MPEG works with both video and audio by throwing out redundant data within a single picture frame, looking for redundant information between adjacent frames, and ending up with a video stream that plays at 30 frames per second (fps) on a CD-ROM. None of the available software compression/decompression schemes (codecs)—such as Intel's Indeo, Media Vision's Captain Crunch, or SuperMac's CinePak—can do this.

The upcoming MPEG-2 standard will be used for broadcast and high-definition television (HDTV). It may be one of the key technologies that squeeze 500 channels onto cable TV.

The first MPEG-1 add-in cards are beginning to hit the market. Sigma Design's ReelMagic uses a C-Cube System's MPEG decoder and will sell for about $400. It can play video at 30 fps at resolutions up to 1,024-by-768 in 32,000 colors and comes bundled with the CD-based game Return to Zork to show off its colors. And Xing Technology has released the $795 XingIt! real-time video capture and playback board. Captured video files can be played back in Microsoft's Video for Windows.

While this is just the beginning, MPEG decoding chips are now being licensed as an option for 3DO game machines and for the cable decoder boxes from General Instruments. Five-hundred channels and nothing to watch?—*Christopher Barr*

Pipeline *By Robin Raskin*

The Origins of Technology

Barry Simon, a longtime friend and *PC Magazine* contributing editor, and Woody Leonhard are coauthoring *The Mother of All Windows Books*. Literally. That's the name of their book, due out momentarily from Addison-Wesley. They're also playing detective, and I thought I'd share the fruits of their investigation.

Last time Barry visited our offices, he sat me down, looked me in the eye and said, "I'm about to show you something that will prove, without a doubt, that Microsoft applications developers have a distinct advantage over other developers."

Exposés aren't my beat, but I was curious. Barry showed me on my multimedia machine a line in my SYS.INI file that read WaveMapper=msacm.drv (MSACM stands for Microsoft Audio Compression Manager). Unbeknownst to me (I can't imagine how I let it slip by me) this driver crept into my multimedia PC.

MSACM offers on-the-fly decompression for ADPCM audio files (audio digital pulse modulation). Microsoft publishes its ADPCM spec so that users can produce compressed files. But MSACM has another trick. It translates 16-bit sound to be played back on 8-bit sound cards. Normally, lower-fidelity sound boards cannot play 16-bit sound. Many vendors give a reluctant sigh and ship the less-rich-sounding 8-bit sound.

"So where can you get the MSACM driver," I asked? Barry hit me with the punchline. To get the driver you must buy and install a Microsoft product. Currently, MSCAM is installed when you install Encarta, SoundBits, or other Microsoft consumer apps. The driver is unavailable to other developers, but will probably (suddenly?) appear in Video for Windows 1.1 and on CompuServe—almost a year after Microsoft consumer apps first used it.

As the saga continued, I learned that MSCAM was developed by the Advanced Technology Group at Microsoft, a group that can dole out solutions to other groups at Microsoft as it sees fit. There's already a "hook" in Windows 3.1, and a hidden icon and applet, to use WaveMapper if it's been installed.

This is not an isolated case of technology appearing first in Microsoft apps. OLE and AVI are other examples. As the provider of both operating systems and apps, Microsoft must make sure that its apps groups are not handed bits of OS technology that are not given to other developers. It's only natural for the Microsoft teams to have some synergy. And any third-party vendor could attempt to figure out how to write a WaveMapper but could not hook it to the OS. There's got to be a better delineation between Microsoft's apps and operating systems teams.

If you're dying to know whether WaveMapper has made its way onto your machine, look in your SYS.INI file for the WaveMapper statement. To enable the applet called SoundMapper, add these lines at the end of SYS.INI:

[MSACM]
EnableControl=1

Restart Windows. If you have one of the Microsoft products installed, you'll see SoundMapper in the Control Panel.

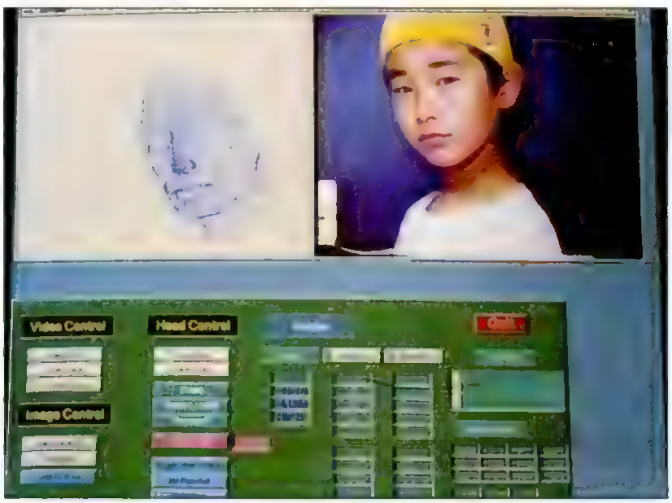
Robin Raskin is an executive editor of PC Magazine.

Japan's Personalized 3-D Interface

AS U.S. SOFTWARE DEVELOPERS duke it out in the never-ending battle of the operating systems, researchers at Sony's Computer Science Laboratory (CSL) in Tokyo have quietly launched a major initiative to develop advanced software. If successful, it could reshape the way you interact with your computer.

In Sony's vision, future computers will recognize and respond naturally to your voice and image, much like a child does. Imagine turning on your PC and being greeted by a lifelike digitized face (of your choosing) that would carry out your spoken commands. That's quite a leap from today's graphical interfaces, but that's the point.

Sony is scrapping the traditional desktop metaphor/graphical user interface that we're all becoming used to. Instead, it's turning the personal computer into a "personalized" computer that displays a speaking face, one with expression, personality, and communication skills.



Sony's interface couples a head animation system with speech dialogue.

To construct the 3-D interface, CSL researchers first built a face-modeling system that aligns and warps a polygon mesh on a series of video still photographs. An interface builder then renders the model by adding a texture map based on facial qualities and simulates facial expressions with the addition of animation information. Technically speaking, the software mathematically spline-deforms the facial surface to simulate the actions of facial muscles, jaw rotation, and eye movement. A control editing system sets combinations of movements in blocks to match emotional states, even generating wrinkles automatically. Once it's fine tuned, the system will depict a range of expressions.

Sony has coupled its head animation system with a speech dialogue system that listens to your commands, decodes the meaning, and chooses an appropriate audible and visual response.

If all goes according to plan, Sony will roll out computer products based on its face-to-face communications model in five to ten years. In the meantime, it will incorporate aspects of the model in consumer products such as VCRs and camcorders.

—*Al Shapiro*

Russian Software Heads West

ENTREPRENEURS FROM THE U.S. and abroad are pitching their business and marketing expertise to computer scientists in the former Soviet Union with the hopes of turning swords into plowshares, or in this case, into snazzy software.

When the Soviet government fell, research funds dried up, and foreign entrepreneurs such as Interactive Products Inc. (503-341-4964) of Eugene, Oregon, sensed an opportunity. IPI funded a group of scientists in Moscow who were working on voice recognition technology. IPI shipped in Western hardware to replace antiquated equipment and a year later is selling the group's first commercial voice recognition software—VoiceMouse and VoiceSqueeze. IRI president Mark Stewart claims that superior algorithms account for 98 percent accuracy rates.

Excalibur's EFS uses advanced pattern recognition algorithms to retrieve text, voice, and video.

The suggestion that Russia holds advantages over the U.S. in certain technologies may be more a matter of perception than reality. "The smartest Americans are distributed in a wide variety of fields, while the Russians are concentrated in the sciences," says Stepan Pachikov, founder of Paragraph International, a Russian-American partnership that developed the handwriting recognition software in the Apple Newton.

Some things are more certain. For one, Russian education in the physical sciences is superior to that in the U.S., says Esther Dyson, publisher of Rel-EAST, the New York-based newsletter that covers technology in Eastern Europe and the former Soviet Union. No doubt there's a pool of highly talented scientists who've developed some nifty algorithms. Excalibur Technologies (800-788-7758), for instance, hired a Russian programmer who developed an advanced pattern-recognition program. Excalibur's Electronic Filing Software (EFS) takes anything that can be broken into a binary format (text, voice, full-motion video), analyzes the bitstreams for patterns, and indexes them for content-based retrieval. The multimedia imaging and retrieval system does true fuzzy searches and handles Russian Cyrillic as easily as Japanese Kanji or English.

Foreign businesses are also flocking east for the money. Many of them agree that you can fund a research project in Russia at a fraction of the cost it would take to develop the technology stateside.

Economics aside, it's clear that the creative juices are now flowing into the consumer market. Paragraph International's Pachikov, for instance, is no less ambitious today than when he began research in handwriting recognition four years ago. Now he wants to predict earthquakes, locate giant oil fields, and build time machines. A program called Alter Ego is his modest attempt to create a multimedia time machine that would send kids traveling through time to experience the last few thousand years of history.—*Carol Levin*

Raising An Einstein

NOW THAT SCHOOL IS BACK IN full swing, kids may be geared up to explore the latest in educational software. Today's computer-based educational software lets kids learn at their own pace, and the game-like quality can make even rudimentary multiplication tables fun. It's a far cry from the way most of us learned our letters and numbers—with books and blackboards, unaccompanied by multimedia games, colorful graphics, and lively sound.

The next generation of children's games goes even further and teaches very complex concepts once taught in only in high schools and colleges. One such program, Kid CAD, from Davidson & Associates (800-545-7677), teaches children ages seven and up the art of computer-aided design.

Kid CAD is a $49.95 Windows game that lets you construct a building brick by brick as a wireframe drawing. You can add furniture, people, animals, and plants. Then, using tools from easily identifiable icons, you can render the objects into distinct 3-D models, zoom in and out, pan, and change the viewing perspective. Without knowing it, they learn about texture mapping and 3-D views. But Kid CAD is a game after all, and a child can choose from a number of fun implements to destroy his creation.

For those children who can't seem to remember their times tables, Compton's NewMedia (619-929-2500) is releasing The Human Calculator. Based upon the mathematics learning strategies developed by Scott Flansburg, billed as "The Human Calculator" himself, this $59.95 program has games to teach students how to add, subtract, divide, and multiply in their heads. When your child completes the program, she'll be able to figure cube roots and tell you what day of the week you were born. —*Christopher Barr*

Top Retail Software

Current ranking	Last issue	Product/ company
1	—	**Quattro Pro 5.0 for Windows** *Borland International*
2	3	**Money for Windows 2.0** *Microsoft Corp.*
3	2	**Microsoft Windows 3.1** *Microsoft Corp.*
4	7	**WordPerfect 6.0 for DOS Upgrade Kit** *WordPerfect Corp.*
5	1	**Access for Windows 1.1 Upgrade Kit** *Microsoft Corp.*
6	14	**WordPerfect 5.2 for Windows** *WordPerfect Corp.*
7	8	**QEMM 7.0** *Quarterdeck Office Systems*
8	10	**WinFax Pro 3.0** *Delrina Technology*
9	—	**Excel 4.0 for Windows Upgrade Kit** *Microsoft Corp.*
10	11	**Procomm Plus for Windows 1.02** *Datastorm Technologies*
11	9	**Quicken 2.0 for Windows** *Intuit*
12	15	**Procomm Plus 2.01** *Datastorm Technologies*
13	12	**Office for Windows 3.0** *Microsoft Corp.*
14	5	**MS-DOS 6.0 Upgrade Kit** *Microsoft Corp.*
15	—	**Lotus 1-2-3, Release 4 for Windows Upgrade Kit** *Lotus Development Corp.*

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending August 21, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram Micro.

Smart Serial Cards

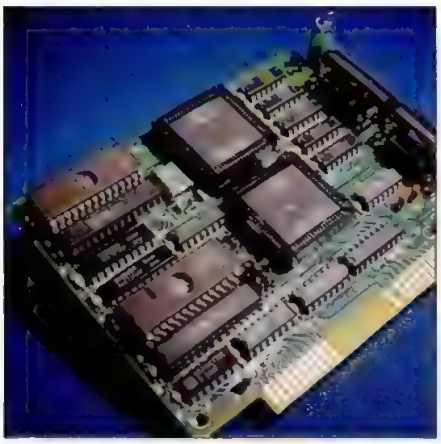
THERE'S ANOTHER BOTTLENECK in your PC. Next time your fax transmission fails, you come across dropped characters in e-mail messages, or your system slows to a crawl when you send a fax, the culprit may be your PC's serial I/O port.

Computers are over 100 times more powerful than the original IBM PC, but serial ports are still designed to handle only 30 characters per second. That wasn't bad for its time—when 300-bps modems were standard—but today's serial ports are asked to move upwards of 3,000 characters each second.

Though using a 16550 UART (universal asynchronous receiver transmitter) on the serial card will avoid data overruns, heavy multitasking will slow performance. The ultimate solution is the *smart card*, which uses its own microprocessor to bust the bottleneck and snap up system performance.

The bottleneck is the hardware interrupt used to tell the PC that the serial port is either receiving or waiting to send data. With data or faxes coming in, even the fastest PC may be unable to service the serial port's small buffer—usually only 1 byte, although 16550 UART cards have 16-byte buffers.

New smart cards include the Digiboard 2Port, which has two serial ports, uses its own microprocessor, and has two 8K buffers. Offloading much of the work normally done by the CPU, it eliminates data overruns and avoids sluggish performance. The Hayes ESP board offers smart card features as well. Both work with several operating systems and cost about $300.



The T/PortTwin serial card has two processors.

Price is another barrier smart cards are breaking. The T/PortTwin from Telcor Systems costs $139.—*Earle Robinson*

Briefs

"NATURAL COMPUTING" MAY SOUND like an oxymoron, but the IBM PC Company is committed to making PCs and people a better fit. Its new philosophy centers on the human element of computing and encompasses good ergonomic and environmental design. The company plans to implement these goals across its product lines.

SOFTWARE PIRATES BILK $1 BILLION from the U.S. economy every year, reports the Software Publishers Association. Pirates in California, Texas, Flordia, New York, and Illinois rank among the worst offenders. To get the SPA Self-Audit Kit, including a software inventory management program (it's free), call the SPA at 202-452-1600.

MISUNDERSTOOD TECHNOLOGY GETS AT-tention. The Association of Color Thermal Transfer Technology (ACT) was recently formed to improve the image of color thermal transfer printers. The consortium of seven manufacturers, including Tektronix, is promoting the technology's high-quality color, low cost per page, and speed.

A $2 BILLION ELECTRICITY BILL?! That's the cost of energy that PCs could save if they were used more efficiently, says the EPA. You could buy a green PC or retrofit your current PC with power-saving features by using the PC Ener-G Saver from PC Green Technologies (714-228-2230). Just plug your monitor, keyboard, and printer into its power strip, and load the TSR. The program senses when your system is idle, then powers down components to meet the EPA's Energy Star guidelines.
—*Carol Levin*

Publishing with Windows Help

FLIPPING THROUGH AN ELECTRONic publication may never be the same as flipping through a magazine. Take this page, for instance. You can browse the headlines, or maybe the red graphic down in the corner catches your eye. Try browsing an electronic publication, and these visual clues are lost.

One creative solution to developing interactive documents is built into Windows itself. The Windows help engine (WINHELP.EXE) is becoming an attractive mechanism for delivering electronic magazines and newsletters. It offers graphics, pop-up definitions, and indexed search capabilities that can turn standard documents into interactive hypertext files.

To create a Windows help file, you first write the document in Rich Text Format (most word processor can save to RTF) with all the graphics and hyperlink information. Then you compile the file using the Windows Help Compiler, which comes with the Windows 3.1 software development kit (SDK).

You don't need to be a programmer to do this. Several third-party help authoring tools are now available to simplify the process. WexTech Systems's Doc-to-Help (212-949-9595) converts Microsoft Word for Windows documents into interactive help files. Windows Help Magician from Software Interphase (800-542-2742) and Robo-Help from Blue Sky Software (702-456-6365) also create documents specifically for the Windows help system. And Microsoft's Multimedia authoring system can spice up your publication with sound and video.

Now that more tools are available to create help files, publishers are starting to distribute interactive electronic newsletters. WinOnLine Review is an electronic monthly magazine distributed worldwide to major on-line services. Compared to a linear document that permits only scrolling, this magazine makes finding, reading, and browsing reviews easy. And unlike print magazines with limited editorial space, the electronic reviews are rich in graphics and screen shots.

The benefits of the Windows help file format have not gone unnoticed by on-line services. ZiffNet now publishes the Monthly Shareware Review, which offers the latest news, highlights, and advice about downloadable software, as well as tips from the Solutions section of *PC Magazine*, both in Windows help format.—*Paul Gudelis*

TRENDS PLUS

The help files discussed here can be found in the Trends section (LIB 5) of PC Magazine's Editorial forum. Just type GO ZNT:EDITOR at any ZiffNet or CompuServe prompt. Search on the keyword "WINHELP."

Photograph by Thom O'Connor

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First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

■ **Is All-In-One the One For All?**

$1,399 Compaq Presario Storms Into Mac Territory

BY DON WILLMOTT

Haven't we seen PCs like this before, and haven't we always hated them?

Yes, and yes. But Compaq's new all-in-one Presario 425 gives you reason to reconsider the antipathy you may feel toward Mac Classic--like systems that make customization and upgrading difficult, if not downright impossible.

At 15 by 13.5 by 14.5 inches (HWD), the Presario is small, taking up no more desk space than a regular monitor, but it isn't wimpy. Inside is a 25-MHz 486SX processor, 4MB of RAM expandable to 20MB, a 200MB hard disk, a fax modem (2,400 bps data/9,600 bps fax) on the motherboard, and two ISA expansion slots. The built-in 14-inch monitor has a maximum 1,024-by-768 by 16 color (interlaced) resolution, though 800-by-600 is a better setting. There are no other monitor options, and you need to keep that in mind.

If you want to get inside to add an expansion card, all you have to do is loosen two screws to pull out a drawer that holds the entire works; it's a fantastic design. While examining the motherboard you'll also spot an upgrade socket for a 33-MHz 486DX, 50-MHz 486DX2, or 66-MHz 486DX2 processor.

TWO PIECES: *Monitor and keyboard, that's it.*

What you won't see inside is any place to install an internal CD-ROM drive, and that's a serious omission in a system designed to appeal to people looking for a PC for use in the home. Compaq hints that multimedia versions of the system will come along in the future; one hopes they arrive soon and with the best possible components.

Outside you find an on/off switch up front, three monitor controls, a single floppy disk drive, and the usual ports in back, including a game port. And that's it. Setup is as easy as getting the system out of the box and plugging it in. Anyone can be up and running in 3 minutes.

SOFTWARE MAKES IT EASY

To make the Presario as attractive as possible to new PC users, Compaq has thrown in quite a bundle of software, including a

Continues on page 38

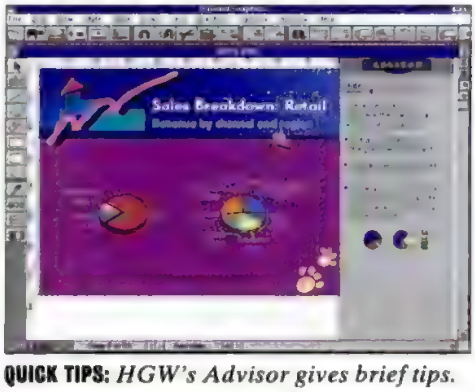
■ **The Latest In Presentations Graphics**

Harvard Graphics 2.0 Catches Up to Competitors

BY LORI GRUNIN

Until now, Software Publishing Corp. has remained relatively aloof from the better-than-thou battle within the presentation software category—a battle marked by products that struggle to balance ease of use with powerful charting, drawing, and organization tools. But Version 2.0 of the company's $395 Harvard Graphics for Windows (HGW) enters the fray with a significantly updated product that offers something for neophytes, upgraders, and veterans alike.

The most visible changes in HGW are those designed to make the product easier to learn and faster to use. The clever 5-Minute Coach tutorial is actually four extremely brief walkthroughs about various aspects of both creating presentations in general and creating presentations with HGW.



QUICK TIPS: *HGW's Advisor gives brief tips.*

While working on a presentation, an optional on-screen Advisor offers generic tips on slide design (such as "Use 6-8 words per topic" for bullet charts) and procedural information (such as "To edit, double-click text"). Rather than leading you around during the creation process, the Advisor simply holds your hand: Novices should find it immensely useful, and

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IN FIRST LOOKS

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Photography by Thom O'Connor

Compaq Presario

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Welcome Center screen that directs you to any of three different help areas, to a setup screen, or straight to Windows. Once in Windows you find software for both America Online and Prodigy; PFS:WindowWorks, an integrated package; Quicken 2.0 for Windows for your personal finances; six Symantec games; and MaxFax, communications software for controlling faxing as well as the Presario's capability to operate as a phone-answering machine. Run a phone line into the included jack and every member of the family can have his or her own voice mail box. (Though Compaq is proud of its software ease of use, it should take a look at the long journey through menus you have to take to figure out how to set up voice mailboxes. Easy it isn't.)

The Presario is also a low-power Energy Star–compliant system. Two utilities easily accessible in the "Compaq Control Center" let you set shutdown intervals for both the monitor and hard disk. Powering back up is just about instantaneous.

BACK DRAWER: *Slides out for easy access.*

BENCHMARKS

In benchmark testing, the Presario was above average compared with other 25-MHz 486SX systems in all categories except one: video. To keep the cost of the system down, there's no local-bus video implementation, and no Compaq QVision either. Video performance is below average for systems in this class, but it's not a fatal flaw.

In fact, the biggest complaint to make about the Presario's otherwise excellent design is an ergonomic one: the system is so small it can seem a little low on the desktop, forcing you to look down at the screen rather than straight at it. Some users will probably want to put a couple of telephone books underneath it for maximum viewing comfort.

Compaq doesn't want anyone to feel alienated by the Presario's unusual design, but anyone who is can turn to the Presario 633, a more conventional desktop PC with a 33-MHz 486SX processor, three slots, and three drive bays. It sells for $100 less than the all-in-one model. Neither system replaces anything in Compaq's ProLinea line; all the ProLinea systems still exist. And like all of Compaq's systems, the Presario machines come with a three-year warranty.

MASS MARKET

By introducing the Presario at a time when it didn't have to dumb down the system to achieve a mass market price point, Compaq has succeeded where other vendors chasing after the Mac have failed. With no monitor options and such limited expandability, the Presario obviously isn't for everyone, but students, people with small home businesses, or anyone with no space to spare should take a look.

• List price: *Compaq Presario 425, $1,399; Presario 633, $1,299. Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269; 800-345-1518, 713-370-0670; customer service fax, 713-378-1442.*

Circle 426 on reader service card

■ **Mass Storage**

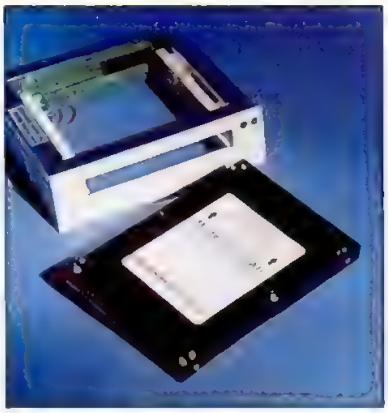
Kalok's Portable Hard Disk Holds 360MB Easily

BY STAN MIASTKOWSKI

There's no denying that removable hard disks are eminently useful: They're hard to beat for locking away sensitive data or for taking your information with you. Kalok's new K-STOR removable hard disk system has taken the concept to a new level of convenience with small, light, and rugged drives that offer high capacities and moderate price tags ($449 for 250MB; $549 for 360MB).

The disks are extremely thin—just a half inch. With dimensions of 4 by 5.75 inches, a K-STOR disk is the size of a small paperback book, and at 10 ounces, it's not much heavier. Kalok, while not exactly a household name, has been making hard disks since 1987 and has gained a reputation for reliability. To use the K-STOR, you need a Kalok P5 docking module, which installs in a standard 5 1/4-inch PC drive bay. Like the disk itself, the docking module emphasizes simplicity and ruggedness. There are none of the fancy and complicated motor-driven mechanics for pulling in and ejecting the drives that are found in competitors' units. Instead, there's just a slot and two LEDs, one to indicate insertion and one to show disk activity.

The K-STOR disks use the standard IDE interface, but there are no jumpers on either the disk or the docking module for switching between master and slave configurations. That's taken care of via software. K-STOR disks are by default IDE masters, but if you're using one as the second (slave) disk in your system or using a pair of disks, setting up one as a slave is a simple matter of running a utility.



CARRY AWAY: *The disks are half an inch thick.*

We measured average access time at a respectable 16 milliseconds, helped along, no doubt, by the drive's internal 128K cache. Rated drive life is an impressive 250,000 hours. Also intriguing is the disks' built-in Flash ROM. You'll be able to upgrade their firmware with a floppy disk.

With a couple of docking modules, Kalok's K-STOR system offers a handy way to transport data between your office and home PCs. And the disks are rugged enough so that you don't need to treat them with excessive care.

• List price: *K-STOR: 250MB, $449; 360MB, $549; additional drives: 250MB, $399; 360MB, $499; additional docking modules, $70. Kalok Corp., 1289 Anvilwood Ave., Sunnyvale, CA 94089; 800-305-2565, 408-747-1315; fax, 408-747-1319.*

Circle 433 on reader service card

Harvard Graphics

CONTINUED FROM PAGE 37

advanced users can turn it off.

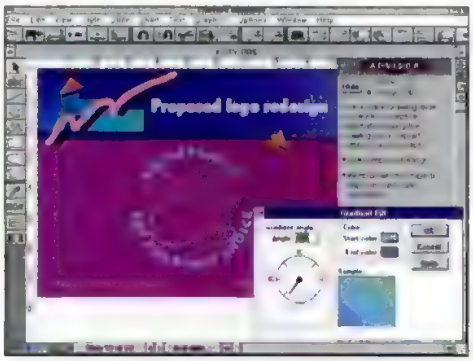
Veterans will appreciate the substantial changes to the interface. Most important, HGW now uses presentation styles, which encompass a variety of chart formats, color palettes, and font attributes; there is also a global master template. These make the package effectively function like the other products on the market; you need never again use the data forms for entering text.

One especially handy aspect of the master template gives you the ability to choose selectively from the master any elements you wish an individual slide to use.

Other me-too features serve to increase the fluidity of your presentation: You can double-click to edit an object or right-mouse-click to edit its attributes; also new are a user-definable icon bar, autosave, TrueType support, standard Windows keystrokes for the Clipboard, and automatic speaker's notes generation. Shrinking text to fit a bounding box is a less commonly found but much-welcomed capability.

Further productivity enhancements take the form of greater visual feedback. One of the most novel, called Quick Looks, gives you an iconic representation of the current element and indicates the affected areas as you pass the cursor over various buttons and options. For instance, if you select the cell labeled "Series 1" in the top row of a bar chart's data sheet, the legend in the icon turns red; if you then select the cell below, the legend grays out and the first set of bars changes color. This is an elegant solution to one of the most confusing tasks in charting: figuring out how the data relates to the chart.

Similarly, when choosing chart layouts, symbols, presentation styles, or simply jumping from slide to slide, the program gives you previews or thumbnails. HGW also lets you drag and drop symbols into your presentation and supports drag-and-drop in the Windows File Manager to open or print files.



TEXT FILL: *With patterns, gradients.*

RANGE FINDER: *Automatic highlights.*

GETTING GRAPHIC

Within HGW itself, you can now quickly and easily format text in a circle and fill it with a gradient, pattern, or bitmap. The program now supports import of AI .EPS files, as well as the import and export of .GIF graphics. But rather than go overboard adding drawing tools to the product, SPC instead bundles Harvard F/X, a modified version of its full-featured Harvard Draw illustration package.

The Quick F/X option (not found in Harvard Draw) lets you quickly and easily create canned special effects such as a water-like reflection, text effects, object sweeps (which look like blends between identical outlines with different attributes, such as fills), and shadows.

Between F/X and HGW, you'll have all the tools you need to create almost any graphic for your presentations, including warps and Boolean operations on paths.

SPECIAL DELIVERY

Delivering your presentation has also gotten easier. HGW's innovative Conferencing lets you run a screen show for as many as 64 users hooked up to a NetBIOS-compatible network. Designed to be used in conjunction with a conference call, Conferencing lets users send brief messages, and the "host" can use the program's On-Screen Chalk to annotate the slides. You can also transfer control of the presentation to another user.

For presentations on the road, the new runtime player supports playback under either Windows or DOS. The autobuild capability automatically builds slides of text or data charts (for instance, a pie chart will build slice by slice).

All the changes bring the product up to snuff without bogging it down (screen redraws, even of gradient fills, are particularly speedy, and intelligently performed). Print quality is excellent in both PostScript and PCL.

But there are still some glitches and omissions throughout the new and the old. For instance, you can't delete cells in DDE-linked data without going to the source application. Also, the choice of bullets remains limited to a handful of predefined symbols.

More damaging was that the player files we generated—HGW creates bitmaps of the slides and creates a single, compressed .PLY file—were of relatively poor quality. While you can specify the resolution for the playback platform, no matter what we tried the fonts appeared broken, jagged, and extremely low-resolution. Under DOS playback, this problem was compounded by poor dithering, even when using an unaltered version of one of the supplied palettes.

Similarly, although SPC has beefed up HGW's sound and video support a bit—you no longer need to launch a player application for sound clips, and video can be integrated using OLE—it remains a lackluster choice for multimedia work.

Nonetheless, Version 2.0 of Harvard Graphics for Windows is seriously competitive with products like Freelance Graphics for Windows and Microsoft PowerPoint. It should please old and new users alike. □

FACT FILE

Harvard Graphics 2.0 for Windows
Software Publishing Corp., 3165 Kifer Rd., P.O. Box 54983, Santa Clara, CA 95056; 800-234-2500, 408-986-8000; fax, 408-980-0729

List price: $395; upgrade, $89 (CD version available for same prices).
Requires: 4MB RAM, 8MB hard disk space (21MB recommended), Windows 3.x.
In short: SPC's interface-lift rejuvenates Harvard Graphics for Windows, making Version 2.0 a desirable upgrade for current users and an appealing choice for new presenters. There's little to compel users of the competition to switch, however.
ON READER SERVICE CARD 432

FIRST LOOKS PLUS

From October 18 through October 22, you can go online to download a demo of Harvard Graphics for Windows or to discuss the program with Lori Grunin and SPC representatives Ray Glosser and Grant Slade. Type GO ZNT:EXEC from any CompuServe prompt.

■ Computer Aided Design

Virtus WalkThrough: Build In an Immaterial World

BY LANCE ULANOFF

In the 1948 film, *Mr. Blandings Builds His Dream House,* Cary Grant spends the entire movie in a state of utter panic as his wife, Myrna Loy, merrily orders one change after another to their new home. If they had owned Virtus Corp.'s $195 Virtus WalkThrough for Windows, Version 1.1.1, they could have tested out all those changes (floorplan shifts and the placement of major fixtures and furniture) in three dimensions and even have taken a walk through their home long before hiring the first contractor.

WalkThrough easily lives up to its billing as a 3-D drawing and *visualization* program, and it's by no means a cheap knockoff of a CAD program. In fact, WalkThrough can work *with* your CAD tool of choice, exporting and importing designs to and from AutoCAD and other .DXF-compatible programs.

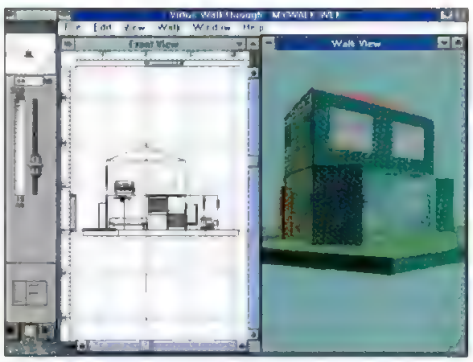
The WalkThrough interface consists of two screens and a screen-length toolbox that changes as you select any one of the design views or the Walk View. As you add and modify design elements, the changes appear almost instantaneously on the Walk View screen. You can position yourself anywhere within the artificial WalkThrough world to watch changes and adjust them properly. Movement through the world is controlled via the mouse. A combination of mouse, Shift, and Control keys achieves the effect of tilting your head up, down, or sideways, or moving it up or down through the virtual world.

TOOLS OF THE TRADE

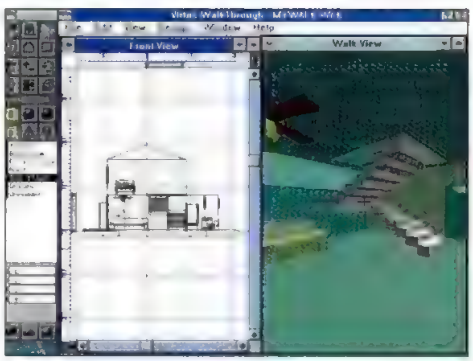
The Design Screen toolbox contains a host of easy-to-use tools, though the icons are not self-explanatory and sorely need some kind of pop-up description. The Walk View tool screen contains just a lens setting (wide to narrow angle) and a tour recording console.

The more you create in Virtus WalkThrough, the more detail you'll want to add to your design. Yet Virtus cautions you to hold back on details—like doorknobs—that can unnecessarily slow down the product. WalkThrough features a layering option to help cut down on confusion in more complex designs. Layers can be hidden, moved, stripped of features, such as windows, or not rendered in the Walk View.

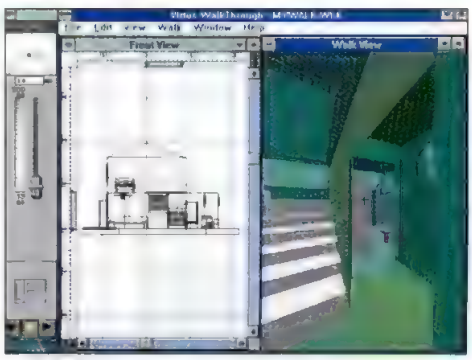
WalkThrough also includes a wealth of sample design structures and libraries of common household, office, and landscape objects.



DREAM HOUSE: *Design (left), and walk (right).*



STEP INSIDE: *Imagine the living room.*



GO UPSTAIRS: *Check out the bathroom.*

Even a virtual world has rules: You can't, for instance, create "walls." Instead, you create "spaces." A design, in fact, is usually a series of connected boxes and other various objects. Every object created in WalkThrough automatically has height, width, and depth. A scroll bar on the left side of the design view controls placement and depth in the virtual world.

As you add boxes to your design, you'll want to create passageways between rooms. WalkThrough's surface editor makes this job easy. Simply select the surface you want to edit, create an opening, and make it transparent.

The tool box also contains lighting control. Lighting values can be set for an object, a set of objects, or for the entire "world" in a wide variety of colors and angles. The latter is controlled in a tumble editor that lets you alternately roll the object or light source to achieve the desired lighting effect.

WalkThrough not only lets you walk around your imaginary, home-grown world but also record a tour and play it back later. Fortunately this is not a memory and hard-disk–hogging animation. Instead, it's a recorded path through your imaginary world. If you change that world, the path remains the same, but the tour reflects the changes.

WalkThrough still has a few bugs. It doesn't, for instance, always flush memory when you exit so when you try to open another application, Windows tells you there's insufficient memory. Also, if you create an object in a locked or hidden layer, a dialog box will ask you if this is okay. If you click on cancel, the box doesn't always disappear, but you regain control of the design screen below. An interim update, which should be available by the time you read this, is expected to address these problems.

But these are just quibbles in the face of a powerful, exciting, inexpensive, and rather easy-to-use product. We bet that even the Blandings family could have conceived their dream house in Virtus WalkThrough's virtual world. □

FACT FILE

Virtus WalkThrough for Windows, Version 1.1.1

Virtus Corp., 117 Edinburgh South, #204, Cary, NC 27511; 800-847-8871, 919-467-9700; fax, 919-460-4530

List price: $195.

Requires: 4MB RAM (8MB recommended), 2MB hard disk space, Microsoft Windows 3.1 or later.

In short: WalkThrough makes it easy to design prototypes in a virtual 3-D world.

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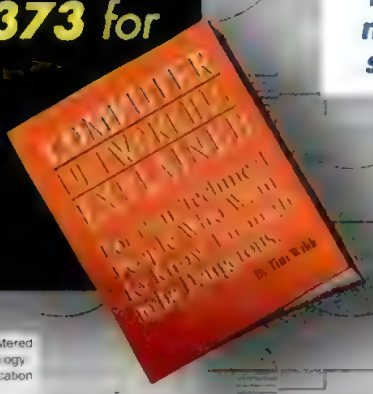

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Forms

Form and Function Meet in InForms

BY LORI GRUNIN

WordPerfect's first foray into the world of electronic forms design software shows promise. The company's $495 InForms package offers a broad array of capabilities for creating both printed and on-line forms to serve as front ends to a variety of common databases. As a first release, however, it suffers from some glitches and oversights.

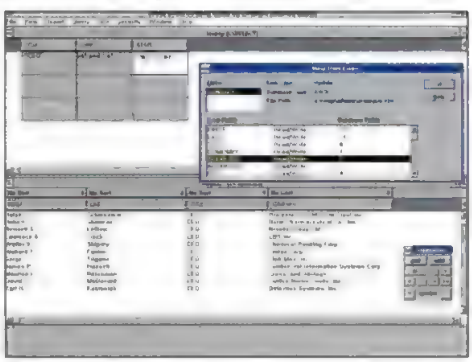
Like its competitors from Delrina and JetForm, InForms consists of a Windows-based Designer module and series of Filler modules; only the Windows-based Filler is currently shipping (DOS is due out by the end of this year).

In the Designer you lay out fields on single or multiple-page forms and link them to one or more data files. InForms strikes an adequate balance between the graphics tools necessary for the creation of printed forms and those necessary for on-line forms, such as radio buttons, drop-down list boxes, and action buttons. You control all object attributes, including colors, and font specifications from one dialog; InForms lets you save a default format, as well as add object types to a library for easy retrieval.

FUNCTIONAL FORMS

Learning to use InForms' graphics design tools is fairly easy; learning to create the database links is a bit harder, but it remains a fairly accessible process for anyone who has a nodding acquaintance with database structures. InForms can access a satisfyingly wide variety of formats and indexes (with varying degrees of flexibility), including Btrieve, dBASE, delimited ASCII, FoxPro, Paradox, and WordPerfect Secondary Merge files, as well as work with a host of SQL back ends.

InForms also lets you create databases from scratch in any of the supported formats. While it claims to import database files, it in fact only imports the structure and fields to speed the layout process. It leaves to you the job of relinking the fields to the data.

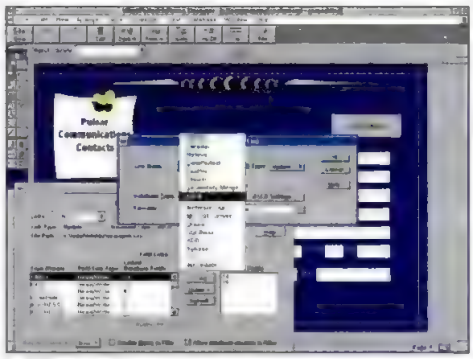


QUERY BY EXAMPLE: *InForms can build queries using Boolean operators.*

In addition to fields with a typical selection of read/write characteristics, password-protected signatures, and auto-increment values, you can create calculated fields based on an assortment of functions, system variables, and form objects, as well as use if-then constructs for controlling field values. Calculations can be set to occur upon field entry or exit. Unfortunately, there are no automatic provisions for data integrity checking; checks must be programmed as calculations.

QUALITY QUERIES

The Designer and Filler share a powerful query engine that has a relatively basic interface. Each linked data file with eligible fields appears in its own window in the query screen; joining data sets is as easy as clicking on the appropriate fields in each window. Results appear in a Report Window, and queries can be stored in a Query Catalog. Any combination of data file formats can be used for joins and queries.



DESIGN POWER: *InForms can create on-screen or printed forms and link to databases.*

While query performance on a single file is fast—the program begins to display results before finishing retrieval—queries aross joined files tend to be slower. For example, retrieving 758 records from two unindexed, locally stored joined files (one with 58 records, one with 758) took over 3 minutes on a 66-MHz 486 system.

And although the query engine supports wildcards, it can't parse a field for a substring; in other words, you can't find "Comden" if the field entry says "Bernstein, Comden, Green."

The Filler lets users add, delete, or update records, as well as browse sequentially through them. The only way to browse a particular record—without programming buttons and calculations—is to perform a full-fledged query and select from the resulting records in the Report Window; the program then loads the chosen records into the form.

FORM LETTERS

The product's e-mail enabling takes two forms: Just the form, or a transport file, which mails both the form and data to users who don't have access to a shared database. Rather than send a pointer to the form's location, InForms sends the entire form—a design decision meant to preserve the integrity of all the data links, but one that discourages extensive use of graphics or other size-bloating elements.

InForms supports several e-mail systems, including WordPerfect Office (versions 3.1 and 4.0), cc:Mail, Microsoft Mail, and MAPI. Conditional form routing is possible, as well. This capability currently exists only in WordPerfect Office 4.0, but by the time you read this, WordPerfect plans to support conditional routing for cc:Mail and MAPI-based products.

InForms shows a lot of potential. The Designer offers the necessary flexibility to create a variety of forms quickly and easily, and it supports an impressive array of databases. The Filler and the search capabilities, however, need some beefing up.

FACT FILE

WordPerfect InForms, Version 1.0
WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; 800-451-5151, 801-225-5000; fax, 801-222-5077

List price: Designer/Filler, $495; Designer, 5-pack license, $1,495; Filler, $199; Filler, 5-pack license, $495, Filler, 20-pack license, $1,495
Requires: Designer: 4MB RAM, 15MB hard disk space; Filler: 4MB RAM, 11.5MB hard disk space, Windows 3.1.
In short: A serviceable 1.0 version that could use some polish in the Filler and query engines
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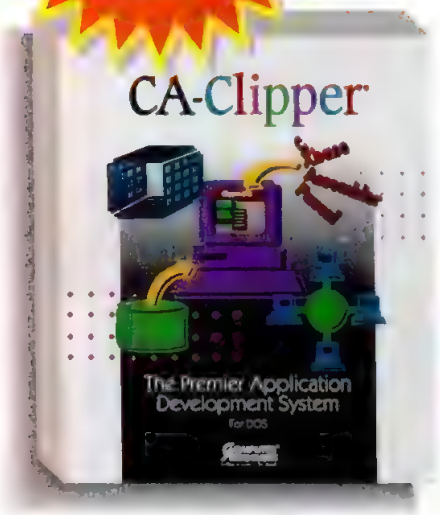

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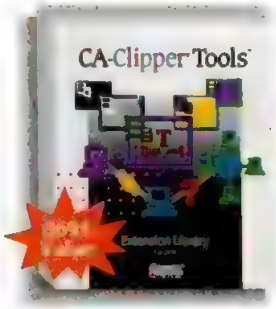

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Code Blocks	YES	NO	NO
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Predefined Object Classes	YES	NO	NO
Variables Modifiable in Debugger	YES	NO	NO
Customizable Reactive Error Handling	YES	NO	NO
Reads and Writes FoxPro (.CDX) Files	YES	YES	NO
Reads and Writes dBASE IV (.MDX) Files	YES	NO	YES
Reads and Writes Paradox (.DB, .PX) Files	YES	NO	NO

Comparison based on FoxPro Version 2.5 for DOS and dBASE IV Version 1.5

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Desktop Publishing

Microsoft Publisher 2.0 Lays Out Big Improvements

BY JAMES KARNEY

Microsoft Publisher 2.0 takes a no-hassles approach to desktop publishing that will endear it to DTP novices and professionals alike. The original version won a PC Magazine Editors' Choice award last year, but was criticized for its lack of styles, templates, auto-hyphenation, and kerning controls. The new $199 package adds those features and about 20 others, including a table editor and better drawing tools.

The improved interface is great. Tools are well organized, and the menus are straightforward. The new toolbar on the left side of the work area gives quick access to text, drawing, and import functions. The ribbon at the top changes as tools are selected, offering instant access to related commands. We had no problem creating a newsletter and a one-page flyer without resorting to the manuals.

Publisher is aimed at new or occasional desktop publishers who work with short, design-intensive documents such as newsletters, brochures, and calendars. The focus is on automating the designing phase. To make it easy, Publisher includes 17 PageWizards, which are essentially macros that work to build generic publications or portions of a document.

To create a basic document, you simply select a Wizard, answer the questions it asks specifying design and layout options, then watch your publication take shape. We were able to add a complex calendar containing dates, days of the week, and a graphic to a page with just a few mouse clicks. Publisher is better at this kind of task than any other DTP package. For inexperienced DTP users, Wizards are a quick way to create a polished design. More experienced users will find them a shortcut for adding complex elements to a document.

In addition to 35 templates for common projects such as newsletters, brochures, and invitations, Publisher 2.0 has styles that let you define the appearance and attributes of a document's design elements, like headings, body text, and captions. Applying the style automatically formats the text. Publisher has also gained better text-handling controls such as kerning and precise leading, drag-and-drop editing, smart quotes, linked frames, and irregular wraps around graphics. Graphics enhancements include 256-color support, a Shape tool, grouping objects, and a logo creation utility.

Publisher 2.0 is an excellent choice for part-time desktop publishers who don't need the fancy color and long-document features of more expensive programs, but demand a functional interface and all the features required to turn out a good design quickly.

• List price: *Microsoft Publisher, Version 2.0, $199 ($139 through December 31); upgrade, $99 ($79 with rebate coupon).* Requires: *2MB RAM (4MB recommended), 6MB hard disk space, Windows 3.1. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400; 206-882-8080; fax, 206-936-7329.*
Circle 420 on reader service card

LOW-IMPACT DTP: *The new Microsoft Publisher has stylesheets.*

Video

Sigma Designs' Concorde VLB Flies High

BY BEN MYERS

The Sigma Designs Concorde VLB is one of the first video boards to use the Tseng Labs ET4000-W32i chip. This latest refinement of the venerable Tseng ET4000 engine allows Windows accelerators to be built with inexpensive but fast interleaved DRAM memory. There are two models of the Concorde VLB: one with 1MB of DRAM at $199, and one with 2MB at $249. The memory on the 1MB model is socketed for expansion.

The Concorde installs easily into a free VL-Bus slot and is likely to work with its factory default jumper settings. A pair of jumpers adjusts the number of wait states between the card and the processor to accommodate variations in system hardware. In our test system (with a Micronics EISA/VL 80486 motherboard), the card worked perfectly with either one or two (default) wait states, but not with zero wait states. Reducing the number of wait states improves performance slightly.

There are two disks of software for the Concorde VLB, each with its own separate installation program. The DOS-based utilities set up the monitor frequencies for various resolutions, enable interleaved operation, install a TSR for VESA BIOS extensions, and install AutoCAD drivers. A slick Windows program manages a painless installation of Windows drivers.

The DOS-based monitor configuration menu allows three sets of monitor frequencies, but there is no interactive screen-calibration utility that lets you adjust monitor frequencies and see the results. If you choose an incorrect frequency, you may find out only after launching Windows or AutoCAD.

The Concorde VLB has Windows drivers for 1,280-by-1,024 resolution with 16 colors, 1,024-by-768 with 256 colors, 800-by-600 with 32,768 or 65,536 colors, and 640-by-480 with 16.7 million colors. It responded quickly at lower color depths, yielding a Graphics Winmark score of 17.9 megapixels per second at 800-by-600 by 256 resolution and 15.2 at 640-by-480 by 65,536. It bogged down, however, with 16.7 million colors, producing a Graphics Winmark score of only 1.90 megapixels per second.

Even though its monitor configuration procedure is less than state-of-the-art, the Concorde VLB offers a super price/performance ratio.

• List price: *Concorde VLB: $199 (1MB), $249 (2MB).* Requires: *VL-Bus PC with an available VL-Bus slot. Sigma Designs Inc., 47900 Bayside Pkwy., Fremont, CA 94538; 800-845-8086, 510-770-0100; fax, 510-770-2640.*
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The Autobahn, Germany
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This $20 billion airport construction project also includes the construction of highways, an airport rail system, a suspension bridge and a cable stay bridge. Projected completion is June 1997.

Kuala Lumpur Tower, Malaysia
This $100 million, 420-meter tower will be the third tallest communication tower in the world. Estimated completion date is 1996.

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Graphics

Morphing: The Latest in Special Effects Fun

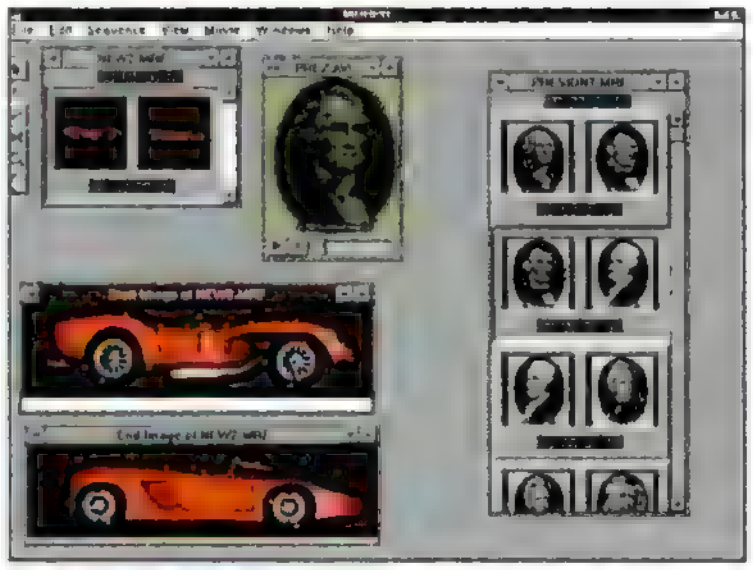
BY JOHN R. QUAIN

If you were one of those kids who blacked out teeth in textbook portraits, these three Windows-based morphing programs will appeal to that image-"enhancing" child within in you. Morphing seamlessly blends one image into another, producing results similar to the liquid metal transformations made famous by the film *Terminator 2*.

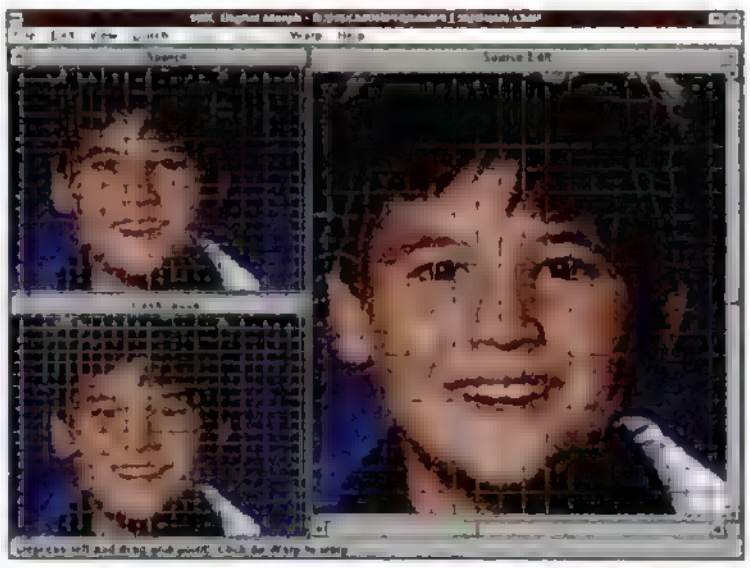
None of these programs—Digital Morph, Morph, or PhotoMorph—have the power to produce those complex and sensational Hollywood effects. But by identifying and then connecting points between your starting and ending images, you can create smooth animated transitions from one image to another or build entirely new composite images for use in business presentations or in such specialized areas as plastic surgery and forensic police work.

All three programs endeavor to make the task as easy as possible, allowing you to create morphs of digitized images, graphics, and animations. Two of the programs, PhotoMorph and Digital Morph, even let you create "warps." Performed on a single image, warped graphics look like pictures that have been placed in front of a funhouse mirror. All three programs can handle 24-bit color images and can recognize the most popular graphic file formats (.BMP, .GIF, JPEG, .PCX, .TGA, and TIFF).

One thing you'll notice about morphing is that it can take time. Using 24-bit color 180- by 200-pixel JPEG images to build a 15-frame morph animation takes about a minute. But if you want to videotape a full-screen animation (640-by-480) in the same format, it will take half an hour to render a one-second morph animation (at 30 frames per second). Furthermore, although animations can be outputed to videotape, the process is still difficult, requiring a fast 486 PC with special hardware and a computer-controlled synchronized VTR.



FAST CARS AND MONEY: *Morph can transform a classic car into a muscle machine.*



CENTER SPREAD: *HSC Digital Morph's flexible warping grid let's you select the distortion area.*

HSC DIGITAL MORPH 1.1

HSC's $149 HSC Digital Morph is the middle child. On the one hand, it lacks the mature strength of PhotoMorph, while on the other it's clumsy when compared with the simpler Morph.

The tools provided in HSC Digital Morph, for example, tend to be cumbersome. Key points are automatically connected in the source image as you assign them, but you can't easily switch between the source and destination image to do point-by-point editing. Furthermore, source and destination images must be the same size, though the program will automatically rescale the destination image.

Digital Morph can generate morphs in background mode, albeit slowly. Informal tests creating animated morphs revealed that Digital Morph was the slowest of the three packages. A simple, 15-frame morph rendering took about four times as long as did comparable morphs in PhotoMorph and about twice as long as those created in Gryphon's Morph.

Finished morph animations can be stored as Windows .AVI files, Autodesk Animator files, or as a sequential series of frames for recording onto videotape. Here, unlike the other two packages, you can't link a series of morphs together in a single file.

The product's real strength lies in its warping abilities: An adjustable-grid image overlay lets you expand or contract image elements by dragging the vertices of the grid in or out.

Overall, HSC's menus and tools aren't as easy to use as those of the other two packages here. This handicap is partially mitigated by such advanced morphing features as line weighting and line strength adjustments, but HSC Digital Morph still has a long way to go to match PhotoMorph's skill set.

• List price: *HSC Digital Morph, Version 1.1, $149.* Requires: *4MB RAM (8MB recommended), 4.5MB hard disk space, Windows 3.1. HSC Software, 1661 Lincoln Blvd., #101, Santa Monica, CA 90404; 310-392-8441; fax, 310-392-6015.*

Circle 429 on reader service card

MORPH, VERSION 1.0

Gryphon's $169 Morph distinguishes itself by what it lacks. It doesn't have a warp effects utility, a screen capture tool, an image editor, or fancy canned effects. Morph is strictly a morphing application. Unfortunately, its single-mindedness will frustrate many users.

Editing and creating morphs in Morph isn't as easy as it could be. Although the reverse cross hairs that assign key points allow you to locate specific spots easily, a single tool bar is used for both the source and destination image.

Despite these complaints, Morph offers some flexibility that the others don't. In edit mode, you can choose to display the lines between key points or just the points, as well as change the color of lines and points. Morph's tension slider control also provides extra precision in creating morph animations. The control gives you the ability to change the line position and color change rates during a morph, making the transition occur more quickly at the beginning or the end of the animation.

Like the other programs, Morph allows you to set the frame rate of a morph, as well as the compression method and image quality. Intel's Indeo compression codec is included, and Morph supports a variety of other compression formats.

Like PhotoMorph, Gryphon's program lets you link a series of animated morphs to run in a single sequence. Animated morphs

can be stored as Windows .AVI files, Autodesk Animator files, or as individual frames in any of the supported formats.

One peculiar annoyance in Morph is that the source and destination images must be the same size. The open file dialog box, for example, will list only files of the same size as your source file.

In general, Morph's documentation and program features are well done, as far as they go. Unfortunately, you'll often wish they went further.

• List price: *Morph, Version 1.0, $169.* Requires: *5MB RAM, 10MB hard disk space, Windows 3.1. Gryphon Software Corp., 7220 Trade St., #120, San Diego, CA 92121; 619-536-8815; fax, 619-536-8932.*

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PHOTOMORPH, VERSION 1.2

By far the strongest of the three morphing packages that are reviewed here, the $149.95 PhotoMorph has the standard morphing and warping effects, but it's the only one that also includes a screen capture utility, animated transitions, a suite of automatic distortion effects, and built-in titling.

For a program that packs so many features into a single application, PhotoMorph is surprisingly simple to use. The main display includes a status bar that conveys information such as the type of file opened, image size in pixels, compression format used, and amount of free system resources.

Extremely flexible and easy to use, PhotoMorph's morphing engine can handle morphs between images of different sizes and color depths. The program comes with a Project Editor that can display the beginning and end images, the frame rate, and the compression method (Indeo3 is included with the program). A mouse click invokes a morph editor to set key points in an image, design a warp, select transition effects, add a title, or choose a canned special effect.

When working on a morph, the source and destination images are displayed side by side. Simply select a point on the source image and it will appear in red on the target. You can edit the morph on a point-by-point basis or you can wait until the first image is done before you go on to adjusting the second.

MAXIMIZED MORPHING: *PhotoMorph features a bevy of automated distortion effects.*

Animations can be outputed as AVI files, Animator files, or sequenced frames, and you can link animated morphs to create mini movies. PhotoMorph also includes a "transition" special effect that lets you switch between animations by using fades and sliding screens.

One of PhotoMorph's minor drawbacks is that it doesn't create animations in the background. On the other hand, it's fast.

PhotoMorph contains several additional graphics utilities including a screen capture program, a basic image editor, and a distortion effects editor that lets you overlay titles on images and choose from a list of preset special effects such as swirls, ripples, spheres, and waves.

• List price: *PhotoMorph, Version 1.2, $149.95.* Requires: *4MB RAM, 4MB hard disk space, Windows 3.1. North Coast Software Inc., P.O. Box 459, Barrington, NH 03825; 603-664-6000; fax, 603-664-7872.*

Circle 431 on reader service card

■ **Alternate Input**

New BallPoint: Better Feel, Better Software

BY BRAD GRIMES

The $125 Microsoft BallPoint Mouse, Version 2.0, is a huge improvement over the original. Its design is much more comfortable, the trackball is easy to control, the serial connector is gone, and the software includes a variety of smart utilities. But with built-in pointing devices—especially front-and-center trackballs—popping up on more and more notebook PCs, you have to wonder, is the new BallPoint Mouse dead on arrival?

The answer is no. The control you get with the new ergonomically designed BallPoint is far superior to that of most built-in trackballs. Two mouse buttons run almost the entire length of either side and are sculpted to fit your finger. If you happen to love front-and-center designs, a third button forms a semicircle around the trackball, making it easy to point and click with just your thumb. The BallPoint Mouse's trackball itself is heavier, smoother, and more resistant than before to give you better control over the cursor.

The serial adapter has been replaced by a PS/2 adapter, so you never have to chose between giving up your serial port and attaching an extra serial-to-PS/2 adapter. The mounting device is designed to attach to your notebook's keyboard and never come off. Now when you pack up your notebook, you can simply snap off the BallPoint Mouse, leaving the attachment clip in place (it adds less than an inch to the notebook's width), and close the case. Be warned, though: The BallPoint is so securely attached to its mounting device that snapping it off can feel more like breaking it.

SMOOTH GROVES: *This mouse fits like a glove.*

Version 9.01 of the BallPoint software includes new utilities that make it easier to use your cursor on LCD screens. Snap-to makes the cursor jump to the default button when you open a dialog box; when you've lost sight of the cursor, Locate helps you by placing it in the center of the screen; and Screen Wrap makes the cursor go to the opposite side of the screen when you move it off one side.

Mouse trails can be enabled, but only with standard Windows EGA, VGA, or Super VGA drivers, and the cursor can be made to appear in three sizes and three colors. There's even a Magnify option that turns the cursor into a magnifying glass for reading hard-to-see parts of the screen. Users of the original BallPoint can upgrade to the new software for $19.95.

• List price: *Microsoft BallPoint Mouse, Version 2.0, $125. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329.*

Circle 435 on reader service card

Applications Development

Omnis 7 Adds Tools for Group App Development

BY STEPHEN W. PLAIN

Blyth Software's Omnis 7 is notable for giving developers the ability to create applications for use on either PCs or Macintoshes without modification. The new Version 2 has powerful new features for the group development of cross-platform client/server applications, but they come with a hefty price tag—$3,750, up from $2,500 for the previous version.

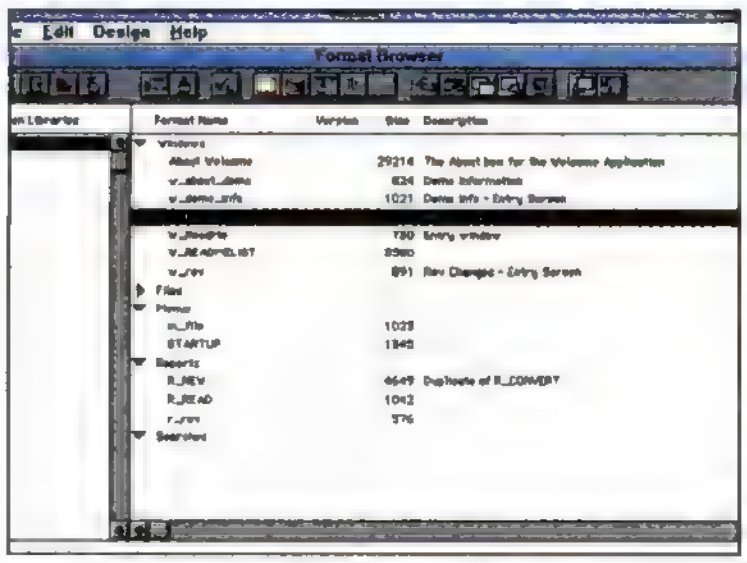
Aimed at developers of end-user applications for use with back-end SQL databases, Omnis competes with products like PowerSoft's PowerBuilder and Gupta's SQL-Windows. A local database engine is included, primarily for use during development of client applications, but it can also be used in concert with remote SQL databases to perform data access locally. Omnis uses a powerful programming language that has over 400 commands. The program has modular interfaces to several SQL databases in addition to the Omnis engine. "Connects" are supplied for DAL servers, EDA/SQL, Oracle, Rdb, SequeLink, and SQL Server.

An Omnis application consists of a set of "formats" stored in a single library file. Using the Format Browser, a mode that lets you deal with all types of formats at once, you can create formats for table structures, menus, windows, reports, and search criteria. Because of the interpretive nature of Omnis, all formats and procedures can be executed at any time from within the development environment.

MAJOR ADDITIONS

A major addition to Omnis is the Shell, an Omnis app that comes with the program. The Shell provides a more graphical and convenient user interface that makes development much easier. While it would have been a smoother solution to build these features into Omnis itself, it's easy enough to work exclusively from the Shell.

The Shell provides workgroup-development and version-control features. The workgroup feature makes it possible for programmers to "check out" objects in order to work on them. Each version of every object can be tracked and reverted to if necessary. These powerful features put Omnis on a par with PowerBuilder and SQLWindows, which have similar capabilities.



RESTRUCTURED: *The new Shell gives developers a more productive way to work.*

Another major addition to the new version is the use of a special notation to refer to just about every component of a library file. This lets you modify and even create new objects from within procedural code. With this notation, you can create self-modifying software that gives end users control over how their application behaves.

Also new to Version 2 is a Change Management System that lets objects that have been updated be automatically transferred to a client workstation the next time it connects to the database. This feature can dramatically reduce the work involved in updating an enterprise-wide application.

WINDOWED DEVELOPMENT

Window formats make up the data entry screens. Omnis can make default window formats automatically, but making multitable forms is much more difficult than it should be. The automatic window generator doesn't handle parent-child windows like invoices, which often have a main record portion and multiple child records from a linked detail table. Instead, you must implement the child section of the window the hard way—through code.

The window painter is not as graphical or full-featured as the one in PowerBuilder, but it is intuitive. There is no formatting toolbar, so text alignment and enhancement require you to go through the menus. You're also limited in the palette of immediate colors—only 16 are available at a time.

The Omnis report writer acts very similarly to the window painter and is able to produce default report formats. Report formats can be defined for letters, labels, forms, and traditional banded reports. In addition to the developer-level report writer, there is an ad hoc reporting feature that can be used to give end users the ability to define their own reports easily on the fly. A graphing module is included that makes line, column, pie, scatter, and other types of charts available in a similar manner. Charts can be manipulated by the user or, through code, by the developer.

The Omnis development package offers a scalable solution to enterprise-wide application deployment. Omnis makes it a relatively simple task to transfer local applications to LAN-based multiuser versions (using the Omnis database engine) and then to a full-blown client/server implementation. This version also gives developers access to the Omnis engine through the use of standard SQL keywords, making it a snap to replicate existing SQL applications locally for development.

Runtime kits are optional and range in price from $120 to $300 per user, depending on the quantity. Through the included deployment tool, you can create distribution disks (with the runtime kits) for your application. It can compress your files and split those that are still too large to fit onto one floppy disk.

Blyth is planning to enhance Omnis 7 with support for ODBC and has recently introduced a version for the AS/400 that will be marketed by IBM. While this upgrade to Omnis offers powerful functionality for the corporate developer, its dramatic price jump may dampen enthusiasm. Nevertheless, Omnis proves to be a productive tool for developing applications for both PCs and Macs.

FACT FILE

Omnis 7, Version 2
Blyth Software,
989 E. Hillsdale Blvd., #400,
Foster City, CA 94404;
800-346-6647, 415-571-0222;
fax, 415-571-1132

List price: $3,750
Requires: 6MB RAM, 6MB hard disk space, Microsoft Windows 3.1.
In short: Version 2 of Omnis 7 includes several new features that make it easier to develop cross-platform apps and bring the program closer to its SQL back-end competitors.

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Introducing the ultimate, pinnacle-of-performance Gateway 2000 P5-60, our super-powered PC, based on Intel's® Pentium™ processor. It's the absolute maximum PC performer available today...at a typical Gateway how-low-can-they-go price of under $3,600! And we haven't faltered on features to give you this incredible price. The P5-60 is loaded with the latest and greatest of technologies — Intel's Pentium CPU, a screaming PCI bus, a 424MB hard drive, 16MB RAM, a 2X CD-ROM drive with a data transfer rate of 300KB per second, along with a 15-inch color monitor, new tower case, and all the extras that come with every Gateway 2000 PC.

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You'll achieve paramount performance with the P5-60's high-tech PCI bus. It's the bus of the future, here today. PCI subsystems are 10-15% faster than comparably configured VESA® subsystems. In addition to PCI performance, you also get the benefits of PCI's "plug and play" feature. Now you can add a modem, network cards, video cards and other peripherals without ever having to reconfigure your system. The PCI bus's 32-bit, high-performing and robust interface is the only logical choice to take full advantage of a Pentium CPU-based system's potential.

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Gateway has always lead the industry in graphics performance, and the P5-60 is no exception. You get the best overall graphics performance available on the market with the new ATI™ Ultra XLR 2MB on the PCI bus. And the unique architecture of the XLR 2MB allows the card to interleave 2MB of DRAM and achieve true 24-bit color at 640 x 480 and 800 x 600 resolutions.

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To top it off, we've added a 2X CD-ROM drive to the P5-60. This latest CD-ROM drive transfers data at 300KB per second, twice as fast as a standard CD-ROM drive.

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The P5-60 comes standard in Gateway 2000's new, smaller tower case, taking you to new levels of expandability. It has 5 external drive bays, 6 internal drive bays and a 300-watt power supply.

For the ***utmost*** in performance, and the ***best*** investment for your future computing needs, the P5-60 is the only system for you! When it comes to being the industry's value-leader, Gateway 2000 has always been a jump ahead of the competition. Call a Gateway sales representative today for more information on the P5-60.

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Gateway customers have come to expect the huge hard drive capacities that we put on our VESA systems. They know that just like closet space, you can never have enough hard drive space. Our 32-bit local bus IDE with exclusive RIDE BIOS still provides you with the industry's leading disk throughput.

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Although everyone tries to catch us — they can never keep up. Our latest ATI Ultra XLR video card still sets the standard for VESA graphics performance. The Ultra XLR also comes with special drivers to accelerate tomorrow's video and multimedia applications. And you get a brilliant, crisp display with our 15-inch CrystalScan® non-interlaced, .28 dot pitch color monitor.

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Secondary caches unlock the full performance potential of your CPU. Gateway VESA systems come standard with 128K cache, and the award-winning DX2-66V with 256K cache.

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Only Gateway gives you a choice of top-shelf application software. VESA local bus and PCI systems include options like Microsoft® Word for Windows,™ MS Excel,™ Borland® Paradox® and Quattro® Pro for Windows, and more. Then we add Central Point's Tools on Top™ utility software, based on the award-winning PC-Tools for Windows. Systems with a CD-ROM drive include Gateway's famous

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System CD containing Microsoft's Multimedia Pack,™ the Gateway Mall and much more. All software is pre-installed on your system at no extra charge.

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For those of you who still want to jazz up your PC ensemble, we're giving you all the instruments you need for expansion. You'll get 4 external drive bays for floppies, a CD-ROM drive, tape backup, and don't forget all the medias of the future. Three internal drive bays allow you to easily add hard drive space. Two VESA slots guarantee upgradeability to tomorrow's totally cool graphics and disk controller technology; and 5 ISA slots are compatible with 16-bit technologies.

Gateway has always had a reputation for marching ahead of the crowd by giving you the ***greatest*** values. Our award-winning VESA systems are no exception. Call Gateway 2000 today and ask your sales representative for more information on these VESA local bus systems.

Standard with VESA systems is our new Baby AT case measuring 16.9-inches wide, 6.6-inch high and 16.8-inch deep.

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The tall and short of it is: Gateway 2000 elevates value to enormous levels on our integrated mini desktop systems... but still gives you pint-sized prices. We've gone to extremes to bring you all new mini desktop configurations with colossal features and performance in a new case. Whether you need a 486SX-25 processor, a 486DX2-66 processor, or anything in-between, Gateway has the system for you. And with prices lower than ever, you get a huge value without having to pay an arm and a leg.

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Check out Gateway's new 4DX2-66 mini desktop — it's a small package that packs a big punch for under $2,000! While other companies might slash their prices, you could get the short end of the stick when it comes to features. Gateway won't short-change you on anything. You get a 66MHz 486DX2 processor, 128K cache, a 340MB hard drive, 4MB RAM and fast video performance. Our 4SX and 4DX models come standard with Microsoft Works™ for Windows; 4DX2 models come with an extended selection of application software. And all mini desktop models come standard with MS DOS® 6 and MS Windows™ 3.1. All application software comes pre-installed on the hard drive at no extra charge.

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Our new integrated local bus video provides up to twice the video performance found in our previous mini desktop systems. In fact, Gateway's mini desktop video performance is similar to that found in many of our competition's high-end systems. With up to 1MB video DRAM, you get 1024 x 768 resolution and an array of colors. All this on our 14-inch CrystalScan non-interlaced, .28mm dot pitch color monitor.

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How can we give you all these features at such low prices? Gateway's engineers went out on a limb to design our mini desktops to include many subsystems incorporated on the motherboard. This means less cost to us, and a giant savings for you!

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You won't have any growing pains with Gateway's new integrated mini desktop cases. They're small, but you get more flexibility and expandability than ever before. These cases come with one internal and one external 3 1/2-inch drive bays, and two external 5 1/4-inch drive bays so you can add a tape backup, CD-ROM drive or another floppy drive. You also get 5 expansion slots: more than you'll find in most small footprint PCs. And all Gateway mini desktop systems are upgradeable to Pentium technology.

With the ***coolest*** features at miniature prices, our mini desktop systems give you an unbeatable value. Call your Gateway sales representative today for more information on these power-packed mini desktop systems.

You get greater expandability with our new mini desktop cases, measuring 16.9-inches wide, 4.4-inches high and 15.9-inches deep.

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A little effort and ingenuity can go a long way. At Gateway 2000, our wheels are always turning to find new ways to become more environmentally conscious. And we haven't just jumped on the "green" bandwagon. Gateway has consistently gone to extremes to reduce waste and pollution, and to increase energy efficiency. When you get your Gateway 2000 system, you can be assured that we're doing our best to make your world a better place.

Recycling and Soy Inks

Gateway has always used recycled paper whenever possible. In fact, this advertisement is printed on recycled paper, using soy ink. Recycled paper is used internally for 75% of our printed materials including newsletters, letterhead, envelopes, invoices and sales literature. Soy ink is used to print 100% of these materials.

Friendly Packaging

All Gateway systems come in boxes made from 50% recycled linerboard. Packaging inside system boxes is made from expanded polyethylene. This environmentally safe packaging contains no CFCs or HCFCs and does not produce any toxic residue when incinerated or deposited in a landfill. Gateway's packaging is recyclable by the manufacturer.

We have also eliminated any ozone-depleting chemicals at our North Sioux City, South Dakota, facility. In turn, we require our suppliers not to use CFCs on or in any parts shipped to Gateway.

On-Line Documents And CDs

Gateway's on-line documentation and System CDs also make a positive impact on the environment. Our On-Line User's Guide is fully interactive so you can learn about your Gateway PC without ever opening a manual. And the Gateway

CAN MAKE THE BIGGEST DIFFERENCE

System CD contains software applications including Microsoft's Multimedia Pack. By putting software and manuals on CD-ROM, we reduce paper waste and other environmental costs of software documentation. It's also a way to replace most of the diskettes that would normally come with your PC. CD-ROMs will eventually replace much of the paper materials and thus, save trees.

Global Releaf

Gateway is a corporate sponsor of Global Releaf, a campaign of American Forests, dedicated to the improvement of the world's environment through the preservation and planting of trees and forests. With our donations, Global Releaf planted over 15,000 trees in 1992. You can help restore damaged forest ecosystems in the United States by calling Global Releaf for more information at 202-667-3300.

Energy Star Program

The Environmental Protection Agency's Energy Star Program is fast-becoming the industry standard in the "green" movement. PCs and monitors with the Energy Star logo are capable of consuming 30 watts or less of electricity. This is right in line with Gateway's philosophy of being environmentally conscious and saving you money. And by providing a high performance computer that also consumes less energy, we're doing the right thing for our customers — and the world.

Gateway is making significant progress in our development of energy-efficient PCs with power-sensitive monitors, energy-efficient CD-ROM drives, high-efficiency power supplies and video cards, and low-power system boards.

We always search for the ***newest and best*** ways to conserve energy and reduce pollution, and to serve as an example of environmental consciousness for the corporate world. Call a Gateway sales representative for more information on our Energy Star-compliant PCs.

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GET THE STRONGEST SERVICE AND SUPPORT

We're committed to bending over backward to please our customers. Gateway employees understand that there may be a time when your computer makes you feel a little weak in the knees. Never fear — our Midwestern people know the importance of a friendly voice and a helpful attitude on the other end of the phone. And they know you want the best in service. So you can count on Gateway 2000 employees to perform feats of great strength to take care of you.

Be assured that we'll be there for you far into the future. Our financial stability has always held steady in the ever-changing PC industry. And although we're not letting it go to our heads, Gateway is one of the largest PC makers in the U.S. and a Fortune 500 company.

Every Gateway system comes with excellent after-the-sale support. You get a **30-day money-back guarantee**. So, if you're not completely satisfied with your system, you can send it back within 30 days for a refund.

All Gateway 2000 systems have a **one-year limited warranty** and telephone **technical support for the life of the system**. When you need help with your PC, you want someone who will jump through hoops to help you. That's what you'll get with our support departments. In February and again in July of 1993, *PC Magazine* readers gave Gateway an excellent rating for service and reliability. And in June, *BYTE* readers chose Gateway 2000 as the company that provides the best service in the industry.

Gateway's **automated fax service** will supply you with detailed documentation on over 150 technical subjects. You'll also get **a lifetime BBS membership** for additional technical support and on-line forums.

We offer **on-site service** to most locations in the country (factory service only for notebooks). And **replacement parts** leave our factory as quickly as possible; we pay overnight shipping.

We also make it easy for you to buy a Gateway PC, with **convenient payment options** including major credit cards and C.O.D. terms Net 30-day term and leasing options are also available to qualified commercial customers.

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This innovative card enables you to make purchases from Gateway and anywhere else MasterCard is accepted, by giving you two lines of credit — one for Gateway purchases and one for all other purchases. For Gateway purchases, the card has no annual fee and a low variable interest rate of just 12.9% APR. For purchases elsewhere, you get a variable interest rate of 13.9% APR and a low $18 annual fee.* If you already have a MasterCard, you may also apply for a Gateway DuoLine MasterCard. Lines of credit will vary by individual. For an application, call 1-800-846-1781.

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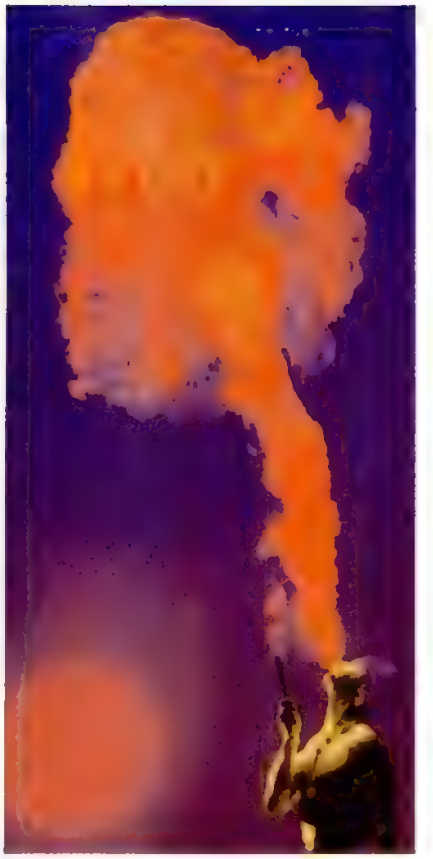

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*Your mail-in rebate will be delivered with your Epson printer. This special price is only good for orders taken through October 31, 1993.

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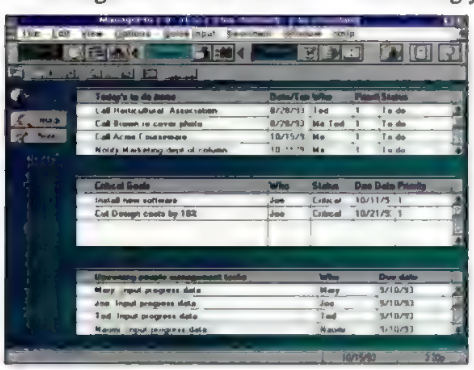
■ **Management**

ManagePro 2.0 Adds E-mail Features

BY RICH MALLOY

The best business management software is now even better. In the new $395 ManagePro 2.0 for Windows, Avantos Performance Systems has added important new PIM, workgroup, and e-mail features to its goal-setting and organizational tool.

ManagePro is one of several new programs being grouped together in the emerging category of "MBA-ware," programs designed to help managers solve specific business problems.



REMINDER: *ManagePro's Assistant highlights your To Do items.*

As with the original version, the new ManagePro does a great job of using a structured approach to help you focus on both your goals and your staff. In its goals section, the software helps you can lay out a spreadsheet of goals and subgoals, assign deadlines, delegate them to your staff, and graphically follow their progress. In the staff section, ManagePro helps you to set up schedules for progress reports and feedback sessions for each of your direct reports. The program has not one but three different ways to remind you of these important but often overlooked tasks.

In this new version of ManagePro, Avantos has enhanced the program's capability to handle appointment calendars and To Do lists. The program now features The Assistant, a large window that does a good job of periodically reminding you of your To Do list, your critical goals, and any progress reports you need to make on your staff. The feature is good enough to inspire some users to throw away their PIMs.

The most important new features, however, have to do with networking. Now you can place your goals database on a network server and share it with any staff member who has a copy of the program. (There are also Macintosh and Unix versions coming.) The program lets you easily designate which parts of your database each staffer can see and which parts he or she can change. ManagePro has a particularly useful read-only option so that subordinates can see their goals and easily e-mail progress reports to you (in MAPI or VIM formats). At your discretion, you can add these to your database with a single click.

Avantos has discontinued a $99 network access module; instead, it offers the full-functioned version at a quantity discount price of $295 each in packs of ten.

The new ManagePro has a rough edge or two, but to quote its included *Managing People* booklet, "you cannot be successful ignoring the good!" And ManagePro is definitely good.

• List price: *ManagePro 2.0 for Windows, $395; ten-pack, $2,995; upgrade, $129.* Requires: *4MB RAM, 15MB hard disk space, Windows 3.1. Avantos Performance Systems Inc., 5900 Hollis St., Suite C, Emeryville, CA 94608; 800-282-6867, 510-654-4600; fax, 510-654-1276.*

Circle 434 on reader service card

FIRST LOOKS PLUS

From October 11 through October 15, you can go online to download a demo of ManagePro or to discuss both the program and business management with Norman Wu and Gerald Huff of Avantos and management consultants William Benson and Edward Kappus. Type GO ZNT:EXEC from any CompuServe prompt.

■ **PCs**

AST Goes Green with New Bravo LP System

BY AMARENDRA SINGH

The Bravo LP 4/66D is part of AST's line of new low-power PCs designed to comply with the federal government's Energy Star program.

Energy Star has a requirement of 30 watts for the CPU and 30 watts for the monitor in "sleep" (conservation) mode. The $3,000 AST machine was able to beat the standard handily with total system consumption of 98 watts in full-power mode and 30 watts in sleep mode. Even in full-power mode, the Bravo LP's CPU was able to consume less energy than Energy Star requires for sleep mode. The system does this by spinning down the hard disk and slowing down the CPU after variable periods of inactivity. The CPU also controls the monitor and powers it down.

None of this efficiency comes at the expense of speed. The Bravo LP performed faster in our CPU, memory, and DOS video tests than the average DX2/66 machine. Windows Graphics performance was helped by an ATI 68800LX processor on the local bus, resulting in higher-than-average performance at 13.1 million Graphic Winmarks.

The system unit has a sleek low-profile chassis and provides limited but adequate expansion for a unit its size. There are two 16-bit ISA slots, both of which were free in our test machine. There is also a proprietary expansion slot for Ethernet, Token Ring, or Etheraudio network cards.

The system has two 3.5-inch drive bays, one for the floppy disk drive and one for the hard disk, plus a 5.25-inch bay that can accommodate a CD-ROM or any other external device you might decide to use.

LOW POWER: *30 watts in sleep mode.*

The Bravo LP is well put together and will go far in allaying fears that low power consumption translates into lower performance or more cost.

• List price: *AST Bravo LP 4/66D, with 8MB RAM, 345MB hard disk, 15-inch monitor, DOS 6.0, Windows 3.1, $3,026. AST Research Inc., 16215 Alton Pkwy., Irvine, CA 92619; 800-876-4278, 714-727-4141; fax, 714-727-9355.*

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Forms

High-Powered FormFlow Automates Paper Traffic

BY DAVID DEJEAN

If your organization needs to improve its handling of forms-based data, Delrina FormFlow is worth your attention. It isn't easy to set up, but the payoff is real.

FormFlow is a big, complex enterprise application, definitely not casual, let-the-users-do-it software. Delrina calls it "workflow" software, and given the current lack of specificity in that term, some explanation is in order.

FormFlow's emphasis is on the practical. This is not the sort of software that lets you model your organization and play "what-if" with information flows. It's a development environment that can be used to convert current paper-based forms applications and noncomputerized information flows to take advantage of PCs and networks.

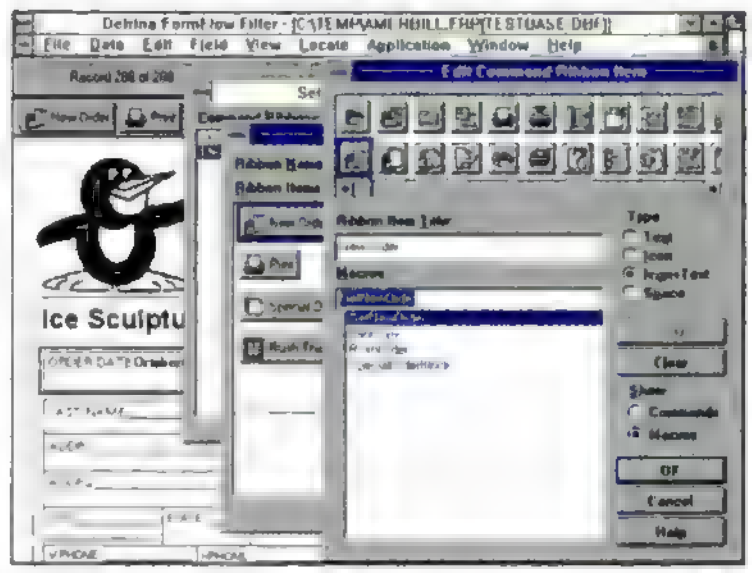
Like any application powerful enough to be used enterprise-wide, FormFlow requires a good deal of effort to master. Installing it for a sizable organization, integrating it with existing databases and mail systems, and building useful form applications will require the dedicated effort of people with knowledge of graphics design, database management, and application development.

The heart of FormFlow is the same engine that drives the most powerful forms-creation package on the market, Delrina PerForm Pro Plus (First Looks, November 10, 1992). FormFlow improves on PerForm's ability to read from and write to standard database formats. It adds forms distribution via electronic-mail systems. And it extends the desktop-publishing metaphor of simple forms design into a complete application-development toolset that lets designers build elaborate Windows applications to create and route data.

WINDOWS STANDARDS

The standard holding all this together, of course, is Windows, and Delrina programmers' fluency with Windows shines throughout the product. FormFlow is split into two modules: Designer provides the desktop-publishing-like tools used to create forms and map form fields to database fields. Filler, as the name implies, is the application users run to select and fill in a form. Designers use Filler to completely customize the environment a form is filled out in: the command menu, icon bar, and buttons that execute macros can be completely different for each form.

Users of FormFlow will find that all the familiar Windows conventions are scrupulously adhered to, yet there are creative solutions to difficult problems like letting the designer see the relationships among databases used by a form.



FORM DESIGNER: *Create an icon ribbon that links complex macros to clickable icons.*

This fluency with Windows makes the program feel consistently manageable, even though it is feature rich and very customizable. Users can create custom dictionaries for that most welcome of features, the spell-checker that works in both Designer and Filler. They can build libraries of frequently used bits and pieces—graphics, name-and-address blocks, fields that depend on elaborate programming. Where Windows has something to offer, FormFlow uses it. DDE and OLE functions, for example, can be built into forms.

The "standards-based" flag also waves over FormFlow's support for a variety of database and electronic-mail products and its security features.

Forms can read data from and write to database files in the major formats: Clipper, dBASE, Paradox, delimited ASCII files, and the major SQL products, including DB2, Microsoft SQL Server, Oracle Server, and OS/2 Data Manager. (Release of the SQL support will trail the release of FormFlow by perhaps 30 days.)

The breadth of this database support makes it possible to integrate FormFlow applications with an organization's existing data processing. An order form can do lookups in customer files and automatically fill in ship-to and bill-to information. Source databases and file formats can be mixed and matched field-by-field within a form.

The list of "standard" e-mail products isn't quite so clear-cut as database managers, but FormFlow supports or will support the usual suspects that have sizable installed bases and offer an application-programming interface: Microsoft Mail (using the MAPI protocol), cc:Mail and Lotus Notes (using VIM), and products that run on NetWare using MHS 1.5, including BeyondMail and DaVinci Email.

The fit between FormFlow and e-mail systems isn't perfect. It's best with Microsoft Mail. FormFlow installation adds a Forms command to Mail's menu, and users can open forms packages from within the program. From the other supported mail systems, they can see they have forms but they must leave mail and start up Filler to work on them.

FormFlow form applications can perform several types of routing: broadcast, serial (moving the form package from one list member to the next in sequence), and conditional or rules-based (letting you set conditions for including or excluding people from the distribution list).

The upside of FormFlow, with its seemingly countless features, is that it's clearly capable of performing big, complex forms automation tasks. The downside is that FormFlow requires a good deal of effort to master. Fortunately, it's worth the trouble. □

FACT FILE

Delrina FormFlow
Delrina Corp., 6830 Via Del Oro, 240, San Jose, CA 95119; 800-268-6082, 408-363-2345; fax, 408-363-2340

List price: Manager (Designer, Filler, and utilities), $399; User (Filler and e-mail support) $199; 10-user license, $1,840.

Requires: 4MB RAM; 16MB hard disk space for Manager, 7MB for User; Windows 3.1

In short: "Forms package" doesn't mean what it used to. FormFlow is a powerful data-management tool that will justify the investment that resources organizations must make to master it

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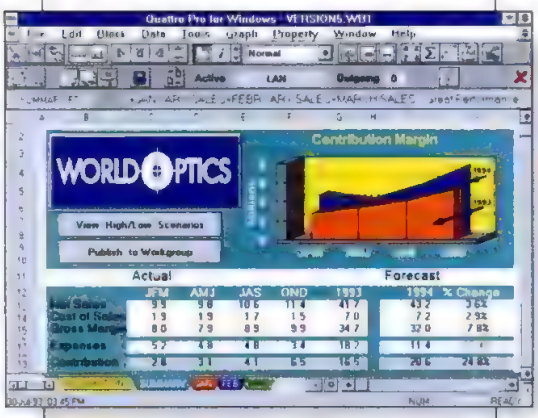

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—PC Week

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■ Windows Utilities

Three New Desktop Enhancers Give Windows 3.1 a Twist

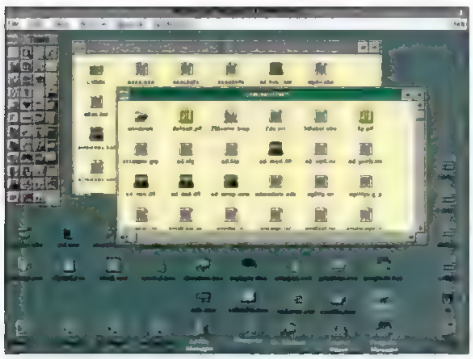
BY BARRY SIMON

The latest barrage of Windows utilities can minimally change your launch/shell operations to alter radically your Windows desktop.

MCDESK FOR WINDOWS

File management under Granite Software's $150 McDesk and Lucid's $90 Third Dimension is virtually identical since both use code licensed from the makers of the now defunct Pubtech File Organizer.

Both place disk drive icons on the desktop, but they don't use directory trees. Rather, as with the Apple Macintosh, subdirectories are represented by folders, and you traverse through directories by clicking and opening intermediate folders, copy and/or move by dragging and dropping between folders, and rename by clicking on the name and editing it. In either program, directory folders can be minimized or open on the desktop.



BUTTON MANIA: *In McDesk, you can add any folder or program to the tool bar.*

Central to McDesk is a button palette that can be set as a long bar just below the menu at the top of the screen, or as a floating rectangular bar. Any program or directory can be dragged to it and added for quick launch or access.

McDesk offers three primary features beyond file management: desktops of objects, including launchable programs, a system button bar, and a command line.

Desktops can be edited, saved, and redesigned, pretty much as you please. Simply add or remove the program or directory you want on the desktop, then save it under a new name. This can be very handy as you move between different sets of tasks.

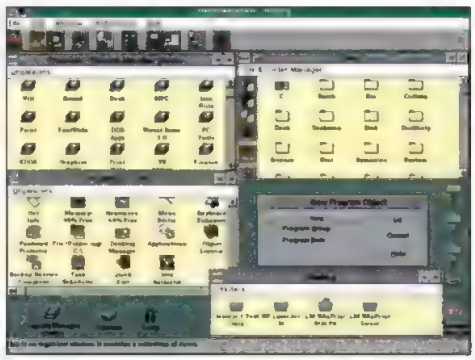
McDesk has its shortcomings. There's no simple way to see what a button does without pressing it and no way to import information saved in your Program Manager groups. McDesk takes a unique but limited approach that will have some appeal, especially for those who liked the old Pubtech environment.

• List price: *McDesk for Windows, Version 4.0, $149.95 ($79.95 through December 31); upgrade from Pubtech File Organizer, $59.95. Granite Software, 12201 Technology Blvd., #130, Austin, TX 78727; 800-880-1744, 512-258-3570; fax, 258-3689.*

Circle 422 on reader service card

THIRD DIMENSION

Third Dimension is a far more ambitious program, offering services beyond the file and launch management you normally find in a shell. You can animate icons, rearrange the menus in its many windows, and make your own button bars.



FILL 'ER UP: *Third Dimension's bulging desktop includes directory folders.*

The tools window includes a scheduler that will run a program at a specified time and a backup/restore module that, unfortunately, does not include tape support. The tools tend to be excessively object oriented. For example, the only way to add programs to the scheduler or directories/drives to the backup list is by dragging the program icon, folder, or drive icon to the corresponding tool icon.

There's so much going on in the Third Dimension desktop that you may find it confusing. Moreover, it has some first-version glitches: We came across some General Protection Fault errors in the icon animator, and the product's conversion of our Program Manager groups had a number of errors. An intriguing and potentially useful program, Third Dimension sometimes acts like it's still stuck in the second dimension.

• List price: *Third Dimension, Version 1.1, $89.95; upgrade from Pubtech File Organizer, $49.95. Lucid Corp., 101 W. Renner Rd., #450, Richardson, TX 75082; 800-967-5550, 214-994-8100; fax, 214-994-8103.*

Circle 423 on reader service card

WINDOWMAGIC

WindowMagic, a $30 shareware product, adds four new functions to Program Manager: It can assign icons to minimized groups, provide right-button quick launch from groups, turn any group into a launch button palette, and provide enhanced Windows exit capabilities offering options.

Once WindowMagic is installed, you can open up one of its icon collections and drag an icon over to a closed Program Manager Group. The icon then appears each time you minimize the group window. The same drag-and-drop method can be used to change group item icons.

If you right-click a closed group, WindowMagic displays a launchable list of the items in the group. Also, one item can be designated to launch automatically when you double-click on the group icon.

WindowMagic can turn any Program Manager group into a quick-launch button palette that you can keep open or minimized outside of Program Manager. If you're not ready to give up Program Manager as your shell, you'll love the extras WindowMagic adds.

QUICK ACCESS: *a pop-up menu exists under closed groups.*

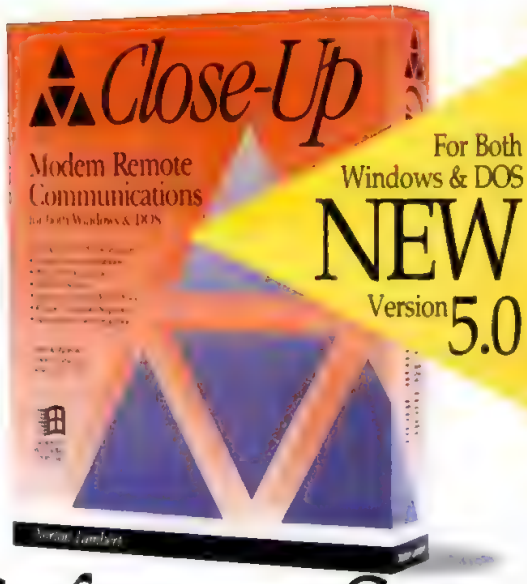
• List price: *WindowMagic, Version 1.1, $29.95 as shareware. WinWear, 14150 NE 20th St., #346, Bellevue, WA 98007; 206-882-1530; fax, 206-557-8324.*

Circle 424 on reader service card

WinBench™ 3.11 by Ziff-Davis Labs Tests Remote Windows™ Speed

This graph shows the speed of the three leading remote control programs when transferring Windows screens. As you can see, Close-Up handles more pixels, faster, meaning you spend less time waiting for Windows screens.

The industry standard test, WinBench 3.11, is perfect for testing the speed of remotes. It is an accurate measure of video throughput. Video throughput is the limiting factor in remote operations, because remote programs must transmit Windows video functions from one PC to the other.



New Remote Software Sets Windows Speed Record

Communicate Faster & Easier

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Close-Up is the only remote communications software that won both PC Magazine's coveted "Editors Choice" and PC World's "Best Buy" awards. Now Close-Up has a new faster & easier version that allows you to view and control another PC by modem as if you were there!

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1. *AI Video Compression*
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3. *Non-Intrusive Technology*
4. *Expert System*
5. *Video Translation*

WinBench scores (average of 10 runs):
Close-Up 1,613,118
pcAnywhere 194,093
CarbonCopy 168,397

Why Is Close-Up So Fast?

Close-Up learns as it works. It uses AI (Artificial Intelligence) to compress all Windows video function calls. That's why Close-Up does so well in Windows Benchmark tests (see WinBench 3.11 chart).

Close-Up uses its revolutionary Photographic Memory™ so that once Close-Up has seen all or part of a Windows screen, it's memorized. Then as screens change, Close-Up only transmits new unmemorized data. Incredibly, with this technology *Close-Up gets faster & faster the longer you use it.*

What Remote Companies Haven't Told You

Other remote programs permanently slow Windows and usually reduce your video resolution and depth of color, even when they are not in memory. That's because they permanently change your system.ini file. Close-Up's breakthrough Non-Intrusive Technology does not modify any of your sensitive Windows files including the system.ini. Close-Up is the only remote that when not in use, allows Windows and your PC to run at normal optimal levels.

Expert System Makes Communications Easy

You don't have to be a communications expert to get the results of one. Close-Up has an Expert System that automatically analyzes system components and configures your system for optimal speed.

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Norton-Lambert

We invite you to reproduce this test. We used two identical Gateway 4DX2-66V's with 66-MHz Intel 486DX2-66 CPUs, 16 MB RAM, 256KB RAM cache, 340 MB HD, IDE controller, no hardware disk cache. Video: Local Bus ATI Ultra Pro with 2MB VRAM, 640 by 480 pixels, 16 colors, VGA.DRV dated 3/10/92. Monitor 72 Hz. MS-DOS 5.0, SMARTDRV 2 MB cache. Modems: two 14,400 baud V.32bis. WinBench 3.11 is available on ZiffNet accessible via CompuServe. Test performed without verification by Ziff. All products are shipping versions. WinBench trademark of Ziff Communications Co. Windows trademark of Microsoft Corp.

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CIRCLE 346 ON READER SERVICE CARD

■ PCs

Dell Dimension XPS: Multimedia Muscle

BY MATTHEW J. ROSS

With its Dimension 466V XPS, Dell continues its marketing strategy of offering fine machines at the top of the power curve for PC buyers looking to maximize their investment.

The $3,227 system (as tested) has everything today's power user needs, including a 66-MHz Intel 486DX2 processor, memory expansion up to 64MB, an external 256K cache, a 450MB Seagate IDE hard disk, a Panasonic double-spin CD-ROM drive, SoundBlaster 16 sound card, mouse, and Windows 3.1. The Dimension line (Dell also offers a 50-MHz version) is Dell's new high-performance, general purpose offering. Dell also just unveiled two other product lines: the Netplex network station intended for corporate needs, and the Optiplex line for Dell's "techno-critical" users.

The Dimension 466V XPS muscles its way through Windows with its fast processor working with a Number Nine GXE-VL local bus graphics card available with your choice of either 1MB or 3MB of VRAM. For video junkies, Dell also offers the Diamond Viper local bus adapter with 2MB VRAM.

Our test system included a 17-inch UltraScan monitor (a $400 option) that had a crisp display and digital controls. You can easily change graphics resolutions inside Windows with just four mouse clicks and no fuss. The drivers are preinstalled, along with Micrografx's PhotoMagic and the CD Sound Effects Library (which includes Multimedia Sound Studio CD), as well as the drivers necessary for the SoundBlaster 16 and the Panasonic CD-ROM drive. Speakers, however, must be purchased separately.

The Dimension packs these impressive features and components into a sturdy medium-size desktop chassis that measures 6.25 inches high with a 16.9- by 16.6-inch footprint. Three drive bays are accessible at front, with a standard configuration being your choice of floppy disk drive at top, an open center bay, and the CD-ROM drive at bottom.

A 450MB Seagate IDE hard drive (Model ST3550A) occupied one of the two internal bays and performed admirably in our test system. Internal expansion is rounded out by two local-bus EISA slots (one of which holds the Number Nine graphics adapter) and five 16-bit ISA slots (one of which holds the SoundBlaster 16 card).

The Dimension 466V XPS's fast video and multimedia support make it perfect for the home or small office, and Dell's 12 networking options embrace the corporate market as well. If you need to be at the top of the performance curve, it's a fine choice.

MULTIMEDIA: *A SoundBlaster is included.*

• List price: *Dell Dimension 466V XPS with 16MB RAM, 450MB IDE hard disk, 15-inch monitor, SoundBlaster 16, CD-ROM drive, $3,227. Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400; fax, 800-727-8320.*

Circle 427 on reader service card

■ PCs

New Power Publishing PC: Is It a Quadra Killer?

BY BRAD GRIMES

Over the years, it's been assumed that for desktop publishing an Apple workstation is superior to anything that exists on the IBM-compatible PC. Today, three vendors—Adobe Systems, Dell Computer Corp., and SuperMac Technology—are pooling their resources and taking on this assumption.

This consortium, The Power Publishing Alliance, isn't developing any new technology. Instead, it's come up with the ultimate bundle for Windows color desktop publishing at a price that's up to 35 percent less than a comparably equipped $14,000 Apple Quadra 800. All the necessities come in one box and at one price.

THREE IN ONE: *Adobe, Dell, SuperMac*

Adobe, Dell, and SuperMac products have been combined to create the $8,995 Dell Power Publishing Superstation, an Intel 66-MHz 486DX2-based EISA system with a 24-bit SuperMatch Thunder/24 graphics adapter and a slew of Adobe software. The Superstation comes with a whopping 32MB of RAM, a 535MB SCSI hard disk, and a SuperMatch 17 color monitor.

Adobe's contribution includes just about everything it's got: Adobe Illustrator 4.0, Adobe Photoshop 2.5, 200 typefaces from the Adobe Type Library, Adobe Streamline, Adobe Type Manager, and Adobe TypeAlign. Then you choose the latest version of either Aldus PageMaker or QuarkXPress to be your core desktop publishing software. Everything is factory-installed.

If you don't require some of the powerful features of the Superstation to meet your desktop publishing needs, you can purchase the $6,995 Dell Power Publishing Workstation, which comes with a 33-MHz 486DX processor, 16MB of RAM, a 230MB SCSI hard disk, and all the same graphics hardware and software as the Superstation. Neither PC, the Dell 466/ME and the 433/ME, has been compromised in any way.

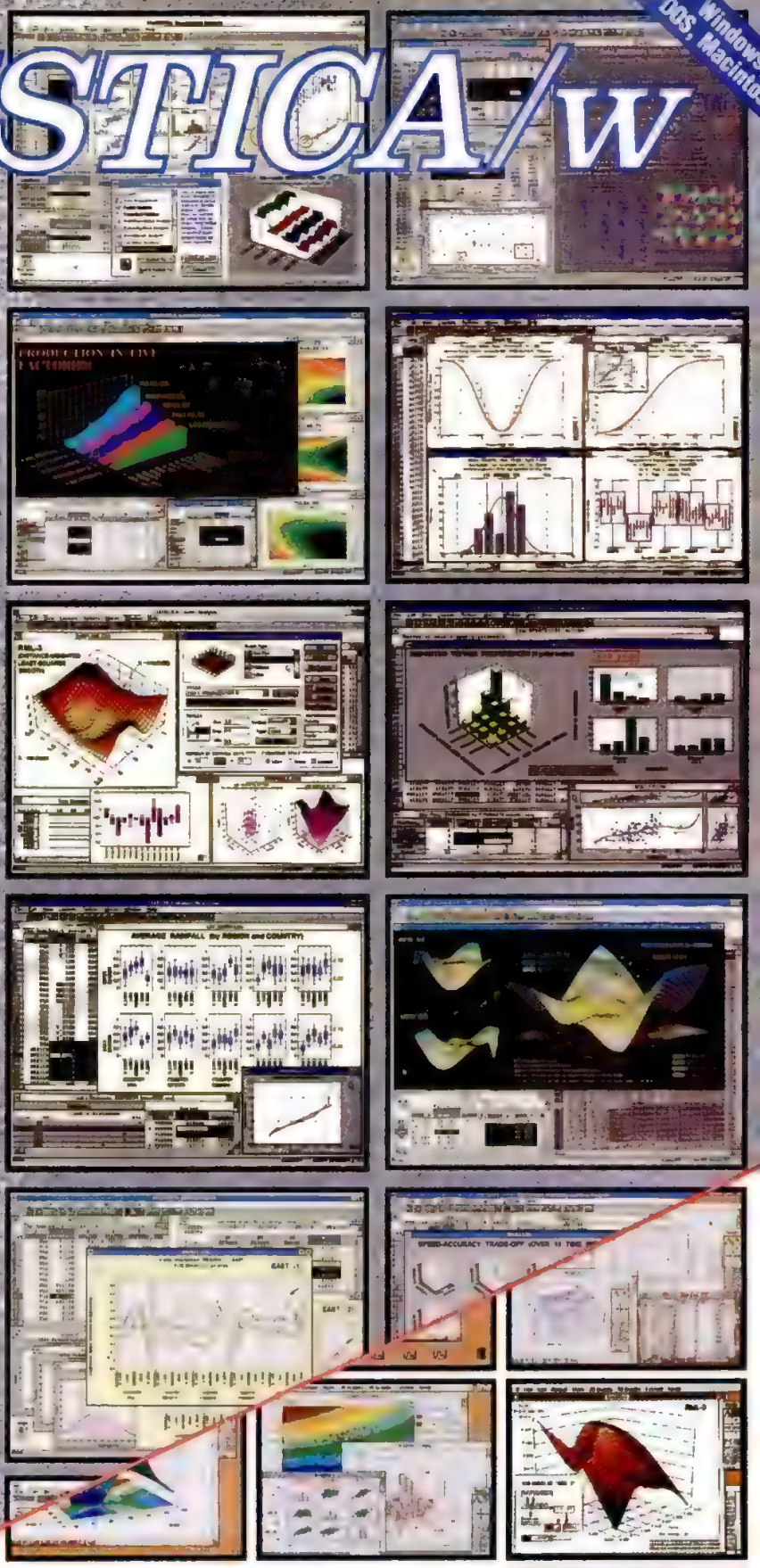
What you don't get in the Superstation are the little built-in extras that are featured in the Quadra, like Ethernet connectivity, but when you consider that there's nothing really new in this great bundle, you have to wonder why nobody thought of it sooner.

• List price: *Dell Power Publishing Superstation with 32MB RAM, 535MB hard disk, MS-DOS 6.0, Windows 3.1; $8,995. Dell Power Publishing Workstation with 16MB RAM, 230MB hard disk, MS-DOS 6.0, Windows 3.1; $6,695. Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400.*

Circle 428 on reader service card

STATISTICA/w

Windows, DOS, Macintosh



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PC MAGAZINE EDITORS' CHOICE
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VESA 640x480@72Hz	•	•	•	•	•	•
VESA 800x600@56/60Hz	•	•	•	•	•	•
VESA 800x600@72Hz		•	•	•	•	•
VESA 1024x768@60Hz		•	•	•	•	•
VESA 1024x768@70/72Hz			•	•	•	•
1280x1024@60Hz				•	•	•
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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Brad Grimes

IMPROVED

Lotus Adds Workgroup Scheduling to Organizer

Lotus Development Corp.'s popular personal information manager, Lotus Organizer, is now in Release 1.1 with features that address the workgroup scheduling needs of cc:Mail for Windows users. Now, if you use Organizer with cc:Mail or any other VIM-compliant e-mail system, you can schedule meetings and resources, search other users' calendars for free time, and respond to meeting requests across a wide area. If you happen to use cc:Mail, you'll also be able to use Organizer across DOS, Macintosh, OS/2, Unix, and Windows platforms. Like other workgroup scheduling programs, Organizer 1.1 has multiple security levels and the ability to let assistants schedule meetings on their boss's behalf. Organizer 1.0 users can upgrade for $49, and Multi-License Packs are available.

• List price: *Lotus Organizer, Release 1.1, $149. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414, 617-577-8500; fax, 617-253-9150.*
Circle 401 on reader service card

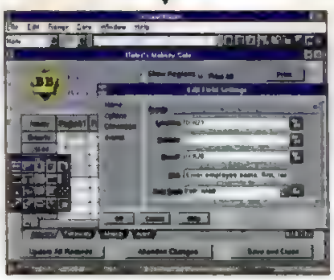
NEW

New 17-Inch Monitor Features On-Screen Programming

Optiquest is bringing on-screen programming to the color monitor market with its 17-inch, flat-screen Optiquest 4000DC. Now you can get a video readout for each adjustment you make to the monitor and control exactly how much the brightness or contrast is changed. The 4000DC also comes with Optiquest's Color Matching System, which lets you adjust color intensity. Together, on-screen programming and color matching give you complete control of the screen. The 4000DC has a 0.28-mm dot pitch; it's capable of noninterlaced resolutions of up to 1,280-by-1,024 and supports a refresh rate of 76 Hz at resolutions of up to 1,024-by-768.

• List price: *Optiquest 4000DC, $899. Optiquest Inc., 20490 E. Business Pkwy., Walnut, CA 91789; 800-853-6784, 909-468-3750; fax, 909-468-3770.*
Circle 402 on reader service card

HOT PROSPECT



Programming Is Now Within the Reach of Spreadsheet Users

Chances are you've used a spreadsheet before, but you may not have used a visual development tool. If you want to build Windows programs but don't know programming, Baler Software Corp. is readying Visual Baler, a spreadsheet-based visual development tool for creating standalone Windows applications. With Visual Baler, you use @functions, macro commands, and other spreadsheet functions to construct applications. If you've already created custom add-ons in Lotus 1-2-3, Visual Baler will import your worksheet and let you develop the application.

Most of what you need in your Windows program is already built when you begin using Visual Baler. You won't need to write routines for functions like File Open and File Save. All the tools you'll need are included: There's a project manager, a spreadsheet editor, a debugger, a visual interface editor, a Microsoft Help compiler, and a distribution file optimizer. Visual Baler also comes with 115 @functions and a 195-command macro language.

Whole applications created in Visual Baler can fit onto one floppy disk, and the list price includes a royalty-free distribution kit.

• List price: *Visual Baler, Version 1.0 for Windows, $495. Baler Software Corp., 1400 Hicks Rd., Rolling Meadows, IL 60008; 800-327-6108, 708-506-9700; fax, 708-506-1808.*
Circle 404 on reader service card

NEW

Okidata Ships Low-Priced LED Page Printer with RISC Chip

The 300-dpi Okidata OL400e LED Page Printer is not a low-end version of the popular OL400. **Okidata**'s latest laser-quality printer uses a 32-bit RISC processor running at 16 MHz to speed up printing. The 4-page-per-minute OL400e has a small footprint of 1.25 square feet; its paper tray is built in. It comes with four typefaces and 44 resident fonts, including U.S. Postal Service PostNet bar codes, and 512K of memory that can be made to emulate 1MB through Enhanced Memory Management. As in other Okidata printers, the light-emitting diode (LED) printhead, which has no moving parts and uses multiple light beams, has a five-year warranty.

The space-saving Okidata OL400e.

• List price: *Okidata OL400e LED Page Printer, $699. Okidata, 532 Fellowship Rd., Mount Laurel, NJ 08054; 800-654-3282, 609-235-2600; fax, 609-778-4184.*
Circle 403 on reader service card

NEW

Parsons Technology Enters Windows Personal Finance Fray

It's not quite free, but it's awfully close. **Parsons Technology**'s $49 MoneyCounts for Windows is the latest entry in the Windows-based financial management arena, bringing with it all of the power of its DOS counterpart. MoneyCounts uses a checkbook metaphor for

Photography by Thom O'Connor

entering transactions in any one of up to 4,000 different accounts. The package comes with 32 reports, charts, and graphs that can be customized to generate over 100 reports, plus a FastFind feature that can quickly locate transactions and a Tax-at-a-Glance feature that estimates your tax liability. Data can be exported to Parsons' tax software, Personal Tax Edge, or converted from MoneyCounts 5.0 to 7.5, Dollars & Sense, Managing Your Money, Microsoft Money, Quicken, and Quicken for Windows.

• List price: *MoneyCounts for Windows, $49. Parsons Technology Inc., One Parsons Dr., P.O. Box 100, Hiawatha, IA 52233-0100; 800-223-6925, 319-395-9626; fax, 319-395-0217.*
Circle 405 on reader service card

NEW

Orchid Delivers New Boards That Excite Eyes and Ears

Orchid Technology is shipping a new VESA local-bus Windows accelerator and a 16-bit digital signal processor (DSP) sound card. The Celsius/VLB, which has 1MB of video RAM, supports color dithering, polygon fill with reference pattern, polygon window mask, and image stretching and scaling. It can be upgraded to hold 2MB of VRAM for 256 colors at 1,280-by-1,024 noninterlaced. It provides 16.8 million colors and a 90-Hz refresh rate.

Also new from Orchid is the SoundWave 32, which supports a variety of sound and multimedia formats including AdLib, SoundBlaster, Windows Sound System, and general MIDI. It's based on the Analog Devices ADSP2115 DSP, which processes over 20 million instructions per second.

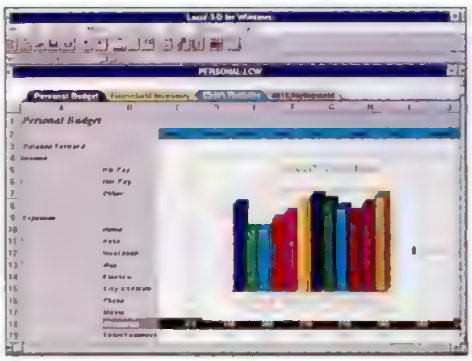
• List price: *Orchid Celsius/VLB, $399. Orchid SoundWave 32, $299. Orchid Technology, 45365 Northport Loop West, Fremont, CA 94538; 800-767-2443, 510-683-0300; fax, 510-490-9312.*
Circle 406 on reader service card

NEW

Lucid Ships Windows Version of Easy-to-Use Spreadsheet

If you're a loyal fan of **Lucid Corp.**'s spreadsheet program, Lucid 3-D, and you're also a fan of Windows, you can finally rejoice in the arrival of Lucid 3-D for Windows. The pioneer of three-dimensional spreadsheets has maintained its reputation for producing fully functional yet easy-to-use products by keeping Lucid 3-D's drag-and-drop interface simple. Spreadsheets can be organized into tabbed folders for easy access and can be linked or used in multidimensional data models.

Lucid 3-D for Windows comes with 50 FastForm templates for home or small office use and over 140 functions. It supports Quicken



The Windows version of Lucid 3-D uses tabbed folders to make spreadsheets easy to use.

files and is compatible with Lotus 1-2-3 and Excel files. Connectivity Packs are available for reading and writing data to and from palmtop PCs such as the Casio B.O.S.S. and the Sharp Wizard. Upcoming Packs will work with the HP 95LX, HP 100LX, and other personal digital assistants.

• List price: *Lucid 3-D for Windows, $109.95. Lucid Corp., 101 W. Renner Rd., #450, Richardson, TX 75082; 800-925-8243, 214-994-8100; fax, 214-994-8103.*
Circle 407 on reader service card

IMPROVED

U.S. Robotics' Courier Line Adds Seven V.32 *terbo* Models

U.S. Robotics has added seven models to its successful Courier line of modems, all of which boast the 19.2-Kbps V.32 *terbo* protocol; in addition, they have U.S. Robotics' own Adaptive Speed Leveling (ASL) technology, which can raise the modems' speed to 21.6 Kbps. Two new high-end models also come with HST Cellular, a proprietary protocol for high-speed data transmission. The Courier *terbo* modems include PC data, PC fax, PC data/fax, PS/2 data/fax, Dual Standard PC data, and Dual Standard PC fax models. Like current Courier modems, the new line of V.32 *terbo* modems is field-upgradable to the forthcoming V.fast standard.

• List price: *Courier V.32* terbo, *$695 to $1,295. U.S. Robotics Inc., 8100 N. McCormick Blvd., Skokie, IL 60076; 800-342-5877, 708-982-5010; fax, 708-982-5235.*
Circle 408 on reader service card

BRIEFS

HARDWARE

Logitech is shipping a new version of its MouseMan ($109). Contoured buttons let your fingers rest comfortably, and Teflon feet provide smoother mouse movement. The MouseMan ships with Enhanced MouseMan 6.3 software, which now has cursor tracking, cursor sizing, and ballistic control. You can upgrade your MouseMan hardware for $45 and your software for $19. 800-732-3173, 510-795-8500.

Also from **Logitech** is the recently announced CyberMan 3-D Controller ($129), a cross between a mouse and a joystick that is aimed at the serious PC game player. A motor that's built into the CyberMan lets you actually get a tactile response from events in a game like being struck or running into a wall. CyberMan is compatible with existing Logitech mice, but to take advantage of 3-D control, game vendors will have to write new drivers. Many vendors have already endorsed the CyberMan, including Access Software, Electronic Arts, Knowledge Adventure, and Sierra On-Line. 800-231-7717, 510-795-8500

The Bocamodem PM1440 Pocket Modem ($395) from **Boca Research** delivers 14,400-bps data/fax capabilities to mobile PC users. It comes with a nine-pin cable, an RJ-11 cable, four AA batteries, a DC power adapter, SofNet's FaxWorks software, and data software for MS-DOS and Windows. With its adapter in tow, the PM1440 weighs just 1 pound. 407-997-6227.

TV Interactive Corp. has announced the LaserMouse family of remote pointing devices (approximately $100 to $150), a series of multimedia remote-control devices that operate like magic wands, responding to wrist movements in free space. The LaserMouse family is compatible with the Microsoft Mouse and can be used to control multimedia PCs, interactive TVs, and game machines. 408-946-2417.

Advanced Digital Systems (ADS) has upgraded its PC-to-video converter, VGA to TV Elite ($399), and announced that the new version will come with Mind Path Technologies' Presentation

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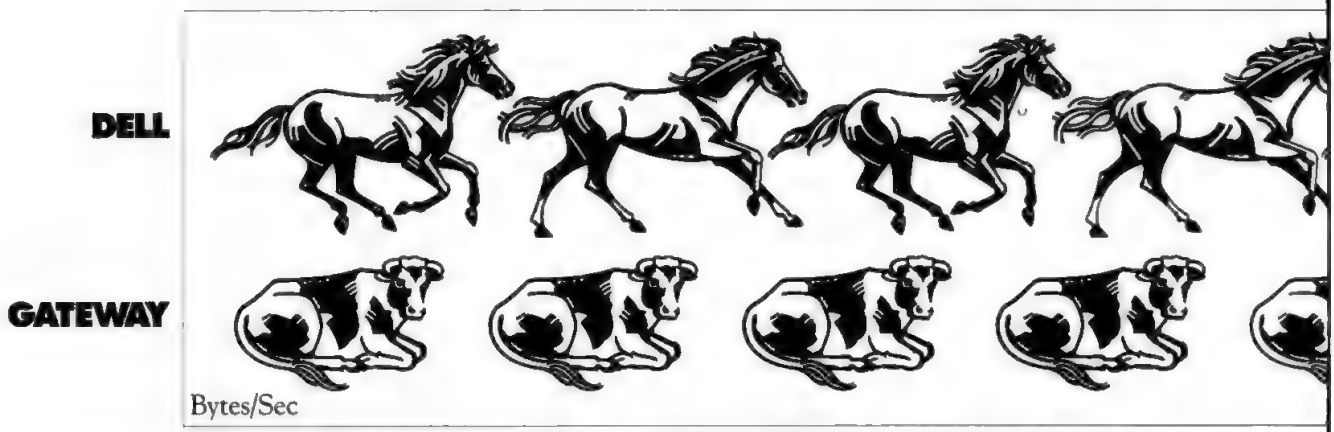
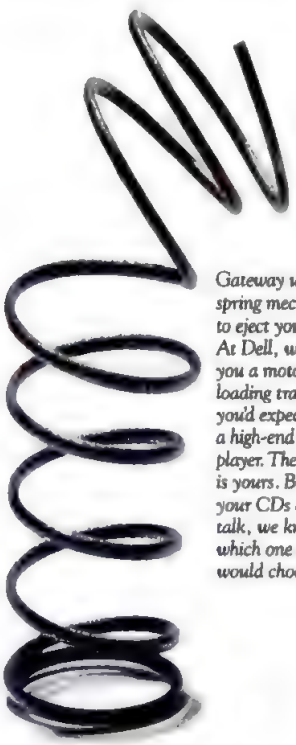


With faster access and nearly double the data transfer rate, our double-spin CD ROM makes Gateway seem positively sluggish.

Thanks to our multi-session CD technology, you can have the disk printed on up to four different times, storing up to 100 color photographs in all.

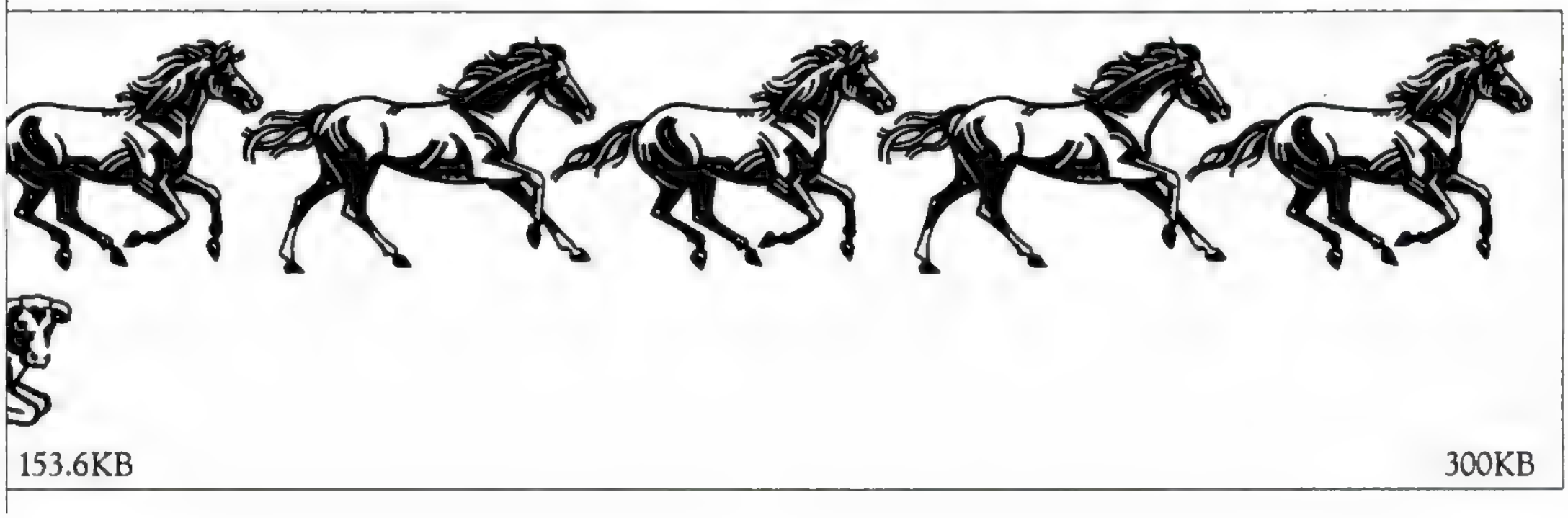


Gateway uses a spring mechanism to eject your disks. At Dell, we give you a motorized loading tray like you'd expect from a high-end CD player. The choice is yours. But if your CDs could talk, we know which one they would choose.

Whistle while you work. Or tap your foot. Or sing along. Our audio center CD ROM software lets you play disc jockey while you carry on with the important work of the day.

*All comparisons based on manufacturers' specifications. The Dell CD ROM is the Panasonic 563. Gateway's CD ROM is either a LMSI CM205 or a Sony CDU-31A. Dell disclaims proprietary interest in the marks and names of

CDs FAST CDs.



When you buy a Dell Dimension™ XPS 450V or 466V equipped with a CD ROM, you get a CD ROM drive that runs circles around Gateway's.*

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†Promotional price expires 11/5/93. *Performance measured by running WinBench version 3.11 at 1024 x 768, 256 colors, using Viper Video Driver ver. 1.1. **Dell assumes no responsibility for face-warping acceleration injuries. †Prices valid in the U.S. only. Some products and promotions not available in Canada. MS-DOS is a registered trademark and Windows is a trademark of Microsoft Corporation. The Intel Inside logo is a registered trademark and i486 is a trademark of Intel Corporation. ◊Business leasing arranged by Leasing Group, Inc. Dell disclaims proprietary interest in the marks and names of others. ©1993 Dell Computer Corporation. All rights reserved.

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IMPROVED

Network Scheduler 3 Now Supports Macintosh Clients

Powercore International's aim with Version 2.0 of Network Scheduler 3 is to make it even easier for enterprise-wide workgroups to schedule meetings and resources across a variety of platforms by adding support for Macintosh clients. The user interface has been completely redesigned and features drag-and-drop functionality and more user options, as well as expanded reporting capabilities across all supported platforms. Now DOS, Macintosh, and Windows users can schedule meetings through a familiar interface, and since Network Scheduler 3 separates the user interface from the calendar database, support for OS/2 and Windows NT can be implemented in future versions.

Version 2.0 introduces Extended Enterprise Support (EES) for managing calendars across a wide area. The main elements of EES are support for vendor-independent messaging (VIM) and the ability to synchronize and distribute the calendar database. The database can now handle unlimited amounts of information.

• List price: *Network Scheduler 3, Version 2.0, five users, $495. Powercore International Inc., One Diversatech Dr., P.O. Box 756, Manteno, IL 60950-0756; 800-237-4754, 815-468-3737; fax, 815-468-3867.*

Circle 409 on reader service card

IMPROVED

New Z-Notes, Z-Lites Feature Innovative Pointing Devices

The newest line of six Z-Note+ notebooks from **Zenith Data Systems** have Intel 486SL processors, 200MB hard disks, and the new NotePoint portable pointing device. The NotePoint is a trackball that juts out from the front of the Z-Note+ and curves down at an angle so the ball is facing you (adding at least an inch in depth). It detaches when you stow the Z-Note+ away during travel. The Z-Note+ line includes two active-matrix color models ($3,899 and $4,399) and one that uses ZDS's new DualBrite technology to provide quality color for less ($3,599) than active-matrix displays.

The new Z-Note+ models sport NotePoint trackballs.

Also new is the Z-Lite 425L, a 3.9-pound subnotebook with an 8.5-inch backlit monochrome display, two PCMCIA Type II slots, and an optional integrated pointing device called the ZDS LitePoint, which attaches to the front of the keyboard.

• List price: *Z-Note+ Model 200, $2,599 to $4,599; Z-Lite 425L, $1,899 to $2,499. Zenith Data Systems, 2150 E. Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331, 708-808-5000; fax, 800-472-7211.*

Circle 410 on reader service card

BRIEFS

HARDWARE

Tools software (New & Improved, May 11, 1993). In addition, ADS has unveiled its Game Blaster ($169), a PC-to-video converter that lets you play PC video games on your TV screen. With Game Blaster, you can also view on-line services like America Online and Prodigy on your TV screen. 800-888-5244, 310-865-1432.

Gennovation is shipping the Parallel Game Port ($45), a hardware/software combination that turns the parallel port of a portable PC into a game port. By installing the software and attaching a gender-changer adapter to the parallel port, you can plug in any joystick, yoke, pedal, or weapon system controller to a DOS-based portable or even desktop PC. Two such devices can be connected using an optional port-doubler cable. 714-833-3355.

Logisys is shipping a series of removable hard disk systems with cartridges that range in capacity from 80MB to 180MB ($399 to $599). Each requires an installation kit ($150) that includes an IDE card and a drive bracket. The key feature of the Logisys hard disks is the ability to hot-swap disk drives without turning off your PC. 800-333-5679, 714-693-1888.

SOFTWARE

Central Point Software has released Version 8.0 of Central Point Backup for DOS and Version 2.0 of Central Point Backup for Windows ($129.95 each). Both versions will now backup to SCSI tape drives as well as to floppy, network, Bernoulli, and QIC 40/80 tape drives. The DOS and Windows versions are now separate and correspond numerically to the version numbers of PC Tools for DOS and PC Tools for Windows. Users can upgrade from previous standalone versions of Backup for $39.95. 800-445-4208, 503-690-8088

Succinct Systems has introduced Sizelt ($49.95), a DOS and OS/2 utility for accessing built-in scalable fonts in HP LaserJet 4—and LaserJet III—compatible printers. Sizelt improves printed output from programs that don't fully exploit a printer's proportional type.

NEW

Microfield Graphics Combines Whiteboard and PC Technologies

Microfield Graphics' new SoftBoard is more than just your typical whiteboard. With SoftBoard, anything you write with special colored markers on its 54- by 60-inch surface is simultaneously displayed, in color, on a connected PC. The data can then be saved, printed, and used in other applications like presentation software. With SoftBoard's built-in data communications ability, what you write or draw can be shared with users at remote sites, adding a new dimension to teleconferencing.

Two infrared beams scan the SoftBoard to detect what you write with your specially encoded dry-erase markers. The beams sense and track the position of the markers in real time and translate that information into data on the PC screen. All you do is attach the SoftBoard to a PC using a serial cable and load the software. SoftBoard Remote lets you set up multisite sessions using modems and standard phone lines.

• List price: *SoftBoard, $2,995. Microfield Graphics Inc., 9825 SW Sunshine Ct., Beaverton, OR 97005; 800-334-4922, 503-626-9393; fax, 503-641-9333.*

Circle 411 on reader service card

NEW

Comshare Spreadsheet Performs Unlimited Data Modelling

Comshare, developer of applications for managing business, has introduced Commander Prism, a Windows-based multidimensional spreadsheet that lets managers view, analyze, and manage large amounts of data and build detailed spreadsheets of up to 64 million cells. Categories of data can be labeled using English-language formulas rather than cell locations, making Prism spreadsheets easier to

use and share. There's also a rules-based Knowledge Dictionary that checks for overlaps in formulas and ensures mathematically correct results. You can define rules that apply over entire regions of a model.

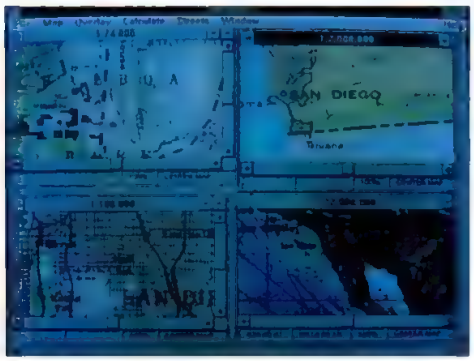
Uses you might have for Commander Prism include budgeting, profit/performance management, sales/marketing analysis, and building Executive Information Systems. A ten-user license is available for $7,200.

• List price: *Commander Prism, $960. Comshare Inc., 3001 S. State St., P.O. Box 1588, Ann Arbor, MI 48106; 800-922-7979, 313-994-4800; fax, 313-769-6943.*
Circle 412 on reader service card

IMPROVED

Sure!MAPS 2.0 Has Windows Version of Mapping

Horizons Technology has introduced a Windows version of its desktop mapping software, Sure!MAPS, and put it together with its DOS version of the product on one CD-ROM. Sure!MAPS 2.0's raster mapping presents you with shapes of large buildings, tunnels, bridges, waterways, and other landmarks. With version 2.0, you can draw lines and shapes to annotate maps or add titles to a map and incorporate them into a presentation. Since the newest version is Windows-based, you can have several



The Windows version of Sure!MAPS makes it easy to see where you're going and where you've been.

screens with different scales of a map open at the same time. The base product has a continental U.S. map and two world maps. With the introduction of 2.0, Horizons Technology is offering 22 optional map sets for more than 60 major metropolitan areas in the U.S. (a significant increase over the 37 metropolitan areas available for Version 1.0) for $99 each.

• List price: *Sure!MAPS, Version 2.0, $199. Horizons Technology Inc., 3990 Ruffin Rd., San Diego, CA 92123-1826; 800-828-3808, 619-292-8331; fax, 619-292-7321.*
Circle 413 on reader service card

BRIEFS

SOFTWARE

The software shows you a menu of the printer's typefonts from which to choose. 800-639-3711, 802-649-5144.

ZyIndex for Windows 5.1 ($395) is the latest version of **ZyLab**'s Windows-based document-retrieval software. ZyIndex 5.1 supports Lotus 1-2-3, Microsoft Excel, and PK.ZIP files. Its sort function will display the results of a search in ascending or descending order based on criteria such as filename, complete path, hits per file, date/time modified, and date/time added to index. 800-544-6339, 708-459-8000

2010 Software Corp. is shipping version 2.0 of Sherlock ($139), the Windows file manager that lets you use 254-character file descriptions as opposed to eight-character filenames. Sherlock 2.0 offers full-text search abilities and support for optical drives and removable media. Sherlock seamlessly replaces the Save and Open dialog boxes in Windows 800-952-2314, 212-887-9555

DiagSoft, a leading producer of diagnostic software, has released version 5.12 of QAPlus/FE ($349.95) and version 4.72 of QAPlus ($159.95). Component tests have been upgraded and system information reporting has been enhanced. Both products provide CD-ROM and SCSI device diagnostics. Users of QAPlus/FE 5.10 or 5.11 can upgrade for $50, and users of QAPlus 4.7 and 4.71 can upgrade for $25. Owners of previous versions can upgrade for $75 and $49.95, respectively. 800-342-4763, 408-438-8247.

Quantum Development Corp. has released Quantum Leap for OS/2 ($995), a 32-bit OS/2 application that uses a client/server architecture to give business professionals modeling capabilities for making complex decisions. You can use Quantum Leap for business planning, financial analysis, asset management, resource allocations, and more. For $295 per year, after the first year, you get all phone support, updates, and upgrades. 302-798-0899

NEW

Free-Form Multimedia Presentation Software Arrives

Super Show & Tell (SST) from **Ask Me Multimedia Center** is a low-cost Windows tool for creating multimedia presentations in an intuitive, free-form environment. All the functions you need to access are on one screen that consists of a preview window, five thumbnail slides, a set of VCR-like control buttons, a set of positioning controls, a slide sorter, a status bar, and a modeless editing section that lets you switch among five media editors. Choosing elements to be included in your presentation is as easy as pointing and clicking. SST supports the popular graphics, animation, sound, and video formats, including .AVI, .BMP, .FLC, .FLI, .GIF, MIDI, .PCX, TIFF, .WAV, and Video for Windows. It also comes with a handbook, *Making Great Presentations on Your PC.*

• List price: *Super Show & Tell, $149. Ask Me Multimedia Center, 7100 Northland Circle, #401, Minneapolis, MN 55428; 612-531-0603; fax, 612-531-0645.*
Circle 414 on reader service card

NEW

PC-InterLink Lets Four PCs Share Files and Printers

Without claiming card slots or I/O ports, **SoftWorx**'s PC-InterLink for Windows connects up to four PCs so that they can simultaneously share printers, transfer files, or exchange on-screen messages. You select a connected printer from pop-up menus that you activate with a hotkey. The print spooler then sends output to a disk file, freeing up your applications, and puts the job in a typical queue where it can be canceled or prioritized. For file transfer, PC-InterLink moves files across the included 100-foot cables at a rate of 27K to 33K per second, depending on the speed of your CPU. The product comes with software, four adapters that connect to the printer port of a PC, four cables, and a junction box that handles the data flow.

• List price: *PC-InterLink for Windows, $229.95. SoftWorx Inc., 1300 E. Arapaho, #208, Richardson, TX 75081; 800-327-5013, 214-480-8278; fax, 214-644-8639.*
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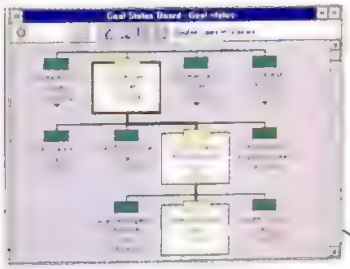
ManagePro is designed to help you stay organized, meet your goals, and excel as a people manager.

With ManagePro, you can be confident that:

- You'll always know the status of your goals and people management activities
- You and your people will clearly see how their performance is impacting key business goals
- You can communicate clear expectations, provide hi-impact coaching, and effectively track employee performance
- You can produce comprehensive reports – *even at a moment's notice!*
- You'll have proven advice on the most common people management issues
- You can keep all your vital management information in one place

Stay on Top of Your Goals

One glance shows you the status of your goals and where you need to focus to keep them on track.

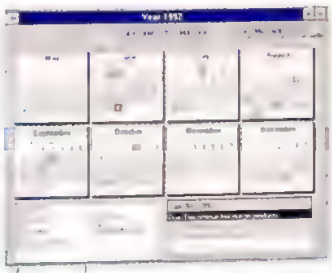


Effectively Manage Your People

One simple screen prompts and prioritizes your people management activities for you.

Take Action

Never miss a deadline or event. View your action plans in a list or calendar format.

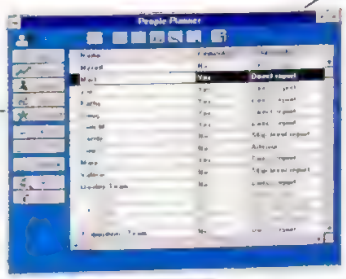


One Click, Maybe Two

That's all it takes to gain instant access to all your important management information from ManagePro's integrated button bar.

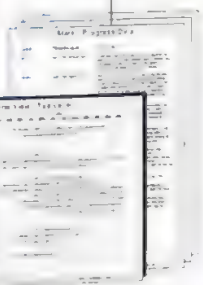
Stay Organized

Easy-to-use planners provide a simple way for you to organize information about your people and manage your interactions to get results.



Instant Reports

More than thirty standard reports are only a click away. Not enough? Create an unlimited number of custom reports.



Management Advisor

Management tips and techniques are always available to help you make decisions.

Capture the Moment

Quickly take notes and rest assured that the information is reflected throughout the program.

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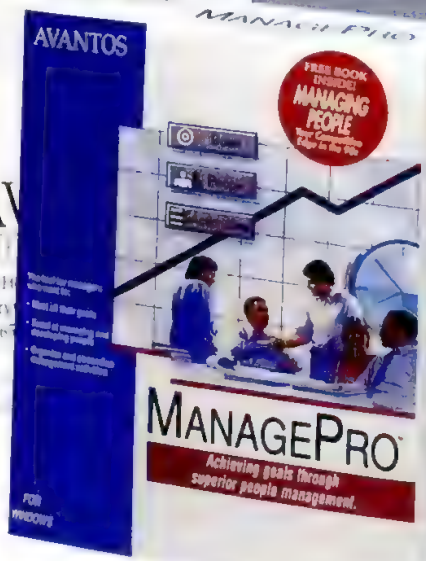

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Edited by Lance Ulanoff

Delving Deeper into the Heart of OS/2 2.1

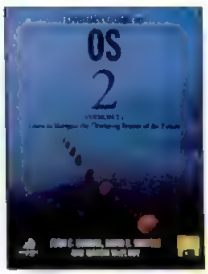
BY EDWARD MENDELSON

The thick manual that comes with OS/2 2.1 tells you almost everything that beginners need to know about the WorkPlace Shell graphical interface—and almost nothing about the command line options and error messages that experts insist on understanding. *Dvorak's Guide to OS/2 Version 2.1* takes the place of the advanced volumes of the manual that don't come in the package.

The book includes a complete account of OS/2's command syntax, the fullest available listing of error messages, and an extensive listing of OS/2-oriented bulletin boards and other sources of information.

The bulk of the book is devoted to the detailed command reference and configuration guide, which includes undocumented features and explanations of why you might want to change many of the settings in OS/2's CONFIG.SYS. Miscellaneous tips in these sections include details on ways to shorten your LIBPATH for greater efficiency. Where IBM's documentation is sometimes wrong, *Dvorak's Guide* sets it right.

The book also contains an introduction to the REXX programming language built into OS/2, plus hands-on details on OS/2's communications, networking, multimedia support, and application development. OS/2's own manuals don't include tips for hardware configuration of individual brands of sound boards, but you'll find a wealth of them in this book. The book's descriptions of the applets that come with OS/2 inevitably overlap those in IBM's OS/2 manual, but *Dvorak's Guide* sensibly keeps these sections brief.



Appendixes include a list of documents available from IBM's fax-back service, a glossary, and hair-raising explanations of hundreds of error messages that you'll probably never see. The book's price is boosted by the presence of a disk of shareware utilities, fonts, and graphics that you can actually download at no charge from most of the BBSs listed in the book itself.

Dvorak's Guide is the work of John C. Dvorak, David B. Whittle, and Martin McElroy—the latter two are well-known OS/2 advocates—and the book's style displays little of Dvorak's extravagance. This is a serious, detailed, dedicated study of OS/2 by authors who know the deepest secrets of a massive and powerful operating system.

• **Dvorak's Guide to OS/2 Version 2.1,** *by John C. Dvorak, David B. Whittle, and Martin McElroy, $45. Random House Electronic Publishing; 212-431-9300. ISBN: 0-679-74648-X.*

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Windows Internals: A Reverse-Engineering Sequel

BY BEN MYERS

In *Windows Internals,* author and programmer Matt Pietrek takes you on a guided tour through the inner workings of the Windows environment. Software engineering theory tells us to use the black box model: You put some information in and get a predictable response back. Most other books, including Microsoft's own extensive official documentation, treat Windows as a black box, considering neither the machinations nor the sequence of events that lead to a final result. But as Pietrek reveals to us with a dense mixture of C-like pseudocode, internal data structure descriptions, and expository narrative, Windows is a complex animal that interprets and embellishes its own published specification, leading to sometimes unexpected results.

The meat of the book is found in three sections that describe Windows start-up and shutdown, memory management, and an interrelated troika of processes, modules, and tasks. Sketchier but still useful sections cover the windowing system, the Graphics Device Interface (GDI), and dynamic link libraries (DLLs).

Pietrek neatly debunks the old wives' tale that the large memory model is an anathema for Windows programs. He also explains how movable, fixed, and discardable memory is *really* managed, contrary to the explanations provided by Microsoft in the SDK. He deftly analyzes the weaknesses and limitations of Windows 3.1 memory management so that you can work within them to develop more robust Windows software.

Of course, *Windows Internals* is rather dry and not intended for a single sitting. But reading it does lead one to the conclusion that Microsoft has not been terribly diligent in cleaning up older code and programming documentation, allowing half-truths about Windows to prevail to this day.

If you write Windows device drivers, very large and complex Windows applications, or esoteric Windows software, *Windows Internals* is a helpful companion reference to its predecessor, *Undocumented Windows.* The book is not rich in actual programming examples, having complete code for only three programs that examine the Windows local heap, global heap, and message queues. But overall, *Windows Internals* is another victory for reverse engineering, telling it how it really is so that we can be more effective developers of Windows software. □

• **Windows Internals: The Implementation of the Windows Operating Environment,** *by Matt Pietrek, $29.95. Addison-Wesley Publishing Co., One Jacob Way, Reading, MA 01867; 617-944-3700. ISBN: 0-201-60834-0.*

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There's more than one way to look at data. And chances are good that the Brand Manager's way will be different from the CFO's. And the Corporate Planner's will be different still. And so on.

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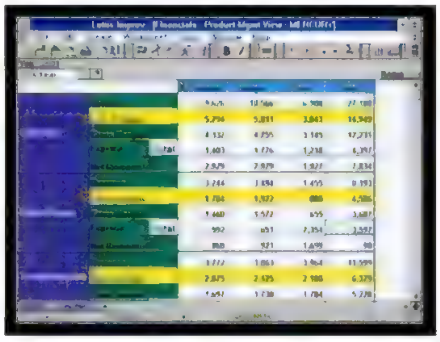

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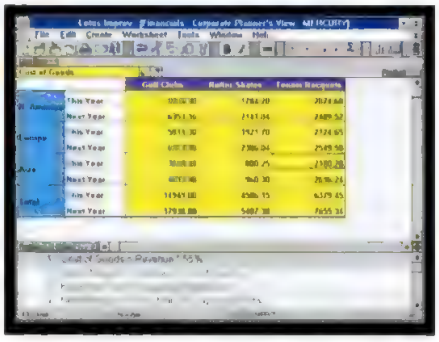

Just drag and drop for a new view, by region. Dynamic Views makes the change instantly.

the cutting and pasting of traditional spreadsheets and none of the potential for error.

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*Anyone who bought Improv Release 2.0 can get the network ready edition of Improv Release 2.1. WK4 support and the Application Field Exchange features free in an update kit. 3+E Extend will not be available as part Improv for NeXT.® CA Compete and Symphony® ***In Canada call **1-800-GO-LOTUS**. ©1993 Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, MA 02142. All rights reserved. Lotus 1-2-3, Lotus of Microsoft Corporation. Quattro is a registered

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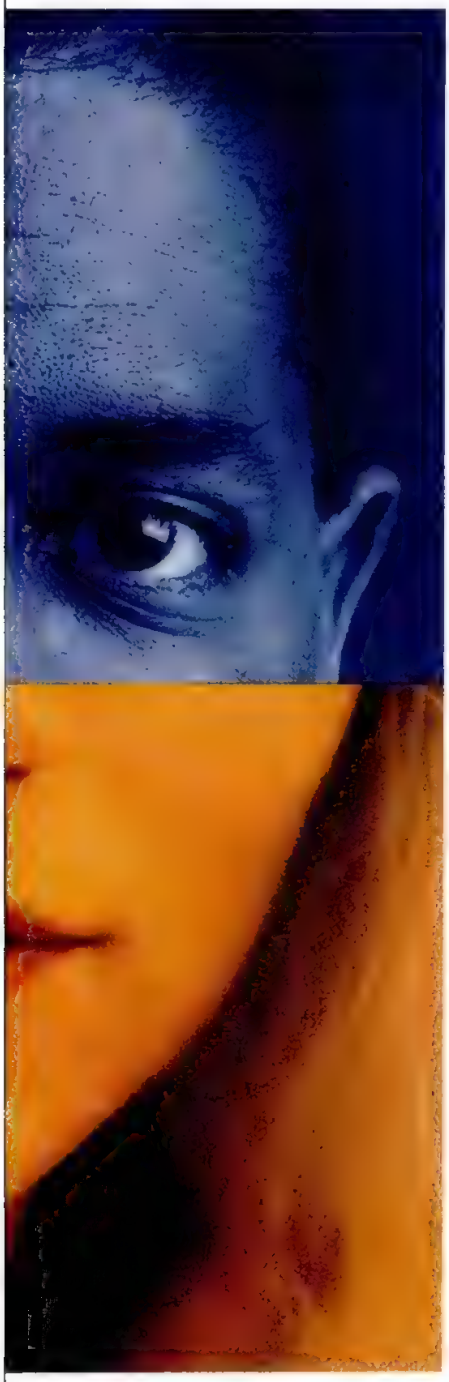
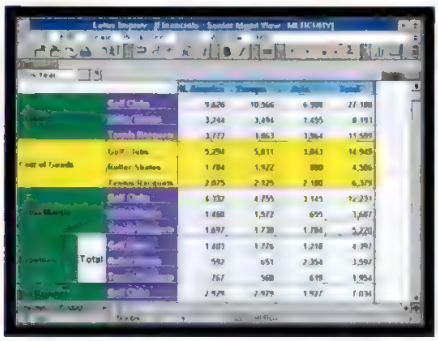
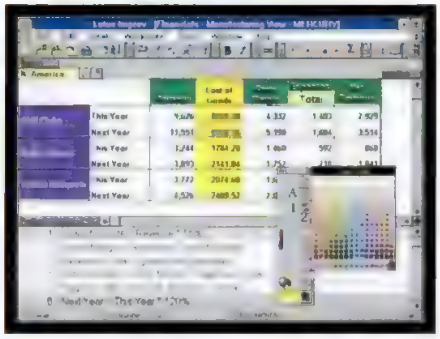


participation and give his people more confidence in their numbers. With Improv there are no cryptic formulas. Everything is spelled out in a way that makes sense. And there's no longer the fear of forgetting to update that one cell.



Drag and drop again for yet another view. You can save different views for future reference.

INTRODUCING IMPROV RELEASE 2.1– DESIGNED TO WORK WITH WORKGROUPS.



Another drag of the mouse to view the data by year. And because the formulas are right there, in plain English, it's easy to follow.

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AT 9 A.M. HE DIDN'T KNOW HOW TO WORK WITH A DATABASE.

When Don Glor came to work on the morning of September 15,* he'd never used a database before. Two hours later he'd developed his first application — it looks like a fire truck: actually it's a customized inventory and billing management system for the South County Fire Department, San Mateo County, CA.

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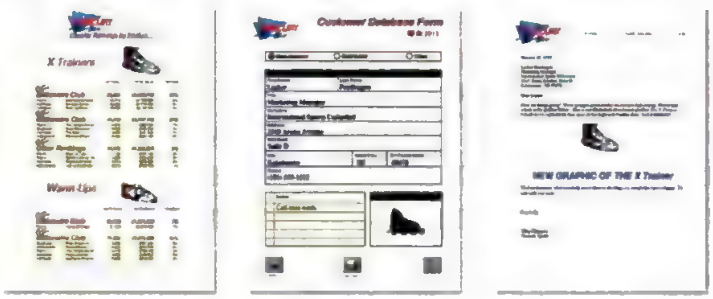
This will surprise anyone who has tried to work with databases like Paradox® or Access.® According to Don, "I tried Access and shelved it. It was just too difficult to get a handle on."

That's not surprising considering the 543 page supplemental language reference for programmers Don would've had to pore through. Which looks like light reading next to Paradox's 1300 pages of programming instruction.

The difference is that their products were not designed for general business users.

With Approach you have database power that really is accessible, and you work in one of four familiar, desktop items — reports, forms, mailing labels or form letters — that look and work just like you expect them to, to help you be productive right out of the box.



Approach lets you get to work right away in familiar, easy to understand desktop items. You can generate reports, forms or form letters — you can even print mailing labels to match any specification.

Approach has won over 25 major industry awards and accolades

AT 11 A.M. HE WASN'T SURE HOW HE'D EVER WORKED WITHOUT ONE.

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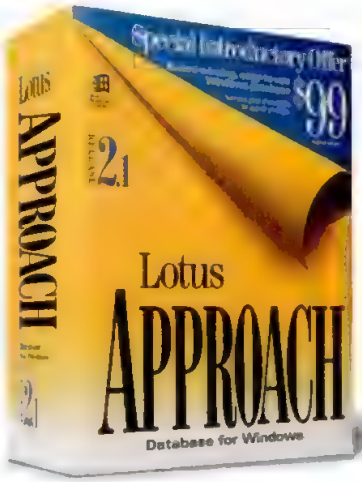

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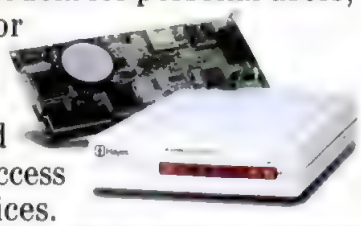

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Toolkits

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

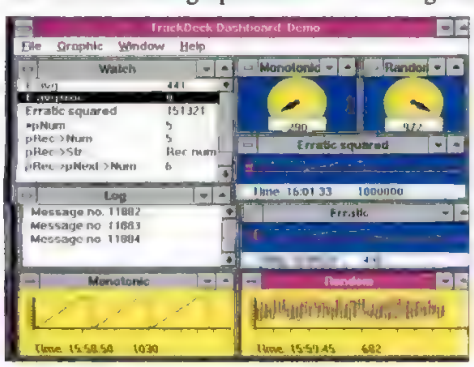
Edited by Sheryl Canter

TrackDeck: A Monitor for Your Program Variables

BY SHERYL CANTER

Like most truly original things, TrackDeck, from Dashboard Software ($129), does not fit neatly into a preexisting category. Tagged by the company as "a dashboard for your program," TrackDeck performs some functions similar to those of a debugger, but with a twist. Using calls to a DLL, it lets you put watches on variables in your Windows programs and then displays the values of the variables over time, using line graphs or dials.

One use of TrackDeck is as a debugging tool—for example, C programmers can track how much of an array is filled so that you can catch overflow errors. With the runtime module (royalty-free, and available to registered users for $10), TrackDeck can also be used for off-site debugging. There is no need to remove TrackDeck calls from your executable to create a production version; without the runtime, the calls are simply ignored. You can also incorporate TrackDeck's graphical displays into your own applications—for example, as part of a network performance monitoring program.



TrackDeck's dials and line graphs show the values of key variables in your program over time.

CREATING A DASHBOARD

TrackDeck has two parts: a DLL called Tracker, whose functions are called from within your program, and the standalone Dashboard executable, which displays watched variables and graphs their values over time. These two pieces communicate through DDE (Dynamic Data Exchange). In order to use TrackDeck, you launch the program you want to monitor and then launch Dashboard. Dashboard both detects executing programs that use Tracker calls and displays a selection list.

When you've selected the program you'd like to track, Dashboard will open two windows: a watch window and a log. The watch window displays all the variables you've placed a "TrackerWatch" on from within your program and continuously updates their values. The log window is an adaptation of the standard debugging technique of inserting print statements at crucial spots within your program; instead of using a standard print statement, you use Tracker calls to route your messages to the Dashboard log window.

You can customize the Dashboard display by opening chart windows for selected variables and by moving and resizing the windows. (The watch and log windows can be resized but not closed.) The dialog box for chart settings lets you select colors, provide a label for the units monitored, and specify the chart's minimum and maximum values. The axes aren't labeled, but when you place the mouse cursor anywhere on a line graph, the values of the *x*- and *y*-axis are displayed below the graph.

When the display is to your liking, you can save the configuration to a file, which can then be loaded the next time you launch Dashboard. The runtime version of Dashboard lets users view only configurations saved with the full version of the program. You can move and resize windows and close graphs or dials, but you cannot create new charts, nor can you save new configurations.

USING TRACKDECK IN PROGRAMS

Incorporating TrackDeck into your programs is simple. You need only call the initialization function, TrackerInit(), and then make one call to TrackerWatch() for each of the variables you want to monitor. Usually, a simple watch on a variable is all that's needed, but if you want, you can monitor a variable's rate of change or a moving average of the values sampled so far. If neither of these is quite what you need, you can compute the tracked value in a user-defined function. The 124-page TrackDeck manual is conversational in tone and gives you detailed information on all TrackDeck's features.

To use TrackDeck as a debugger, you must set up and monitor variables that indicate where you are in the code as the program executes. By default, watched variables are sampled every 200 milliseconds, but the sampling rate can be set to something different through the TrackerSetInterval() function. If necessary, a call to TrackerUpdate() can be used to force sampling to occur immediately.

Because sampling is relatively infrequent and the DDE transfer is quick, TrackDeck generates only a small performance hit. And until you actually launch Dashboard or another DDE client, performance is not affected at all. This means you can bury Tracker calls in your program and use Dashboard only when a problem arises that you want to track. This is especially useful for remote debugging at a client site. Useful for debugging, profiling, and performance monitoring, TrackDeck is a unique hybrid with many potential applications. □

• TrackDeck, Version 1.0
List price: *$129 (runtime costs $10 and can be distributed without royalties).* Requires: *Microsoft Windows 3.0 or later and one of the following: any C/C++ or Pascal compiler, Microsoft Visual Basic, Borland ObjectVision, or any other Windows programming language capable of incorporating DLL calls and passing addresses. Dashboard Software Inc., 4 Louis Ave., Monsey, NY 10952; 914-352-8071 (voice and fax).*

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The BJC-600 Color Printer In Black And White.

At Canon®, we think that before you go out and buy a personal color printer for your home or small office, you should have all the facts in black and white. And have them right in front of you.

So, let's start with the quality of our print.

The new Canon BJC-600 prints 360 dpi for both brilliant color and crisp black and white output on plain paper. Other color printers, print a mere 300 dpi.

We also use inks that are richer and more vibrant. And to eliminate cross-color bleeding on plain paper, our inks have been made to dry much faster than conventional inks.

Now, what's the graphics print-out speed like?

Faster than you'd expect from a personal color printer. That's because the new BJC-600 print head has 192 color nozzles, compared to as few as 48 on other personal color printers. And to further help speed it along, the BJC-600 is designed to print color in both directions across the entire page.

Okay, how about all the little hidden costs?

Not here. The cost-per-page of the BJC-600 is a fraction of what you would normally pay for color printing.

Unlike most other color printers, the BJC-600 has 4 separate ink cartridges — one for each color. So when you run out of one color you don't have to replace all the others.

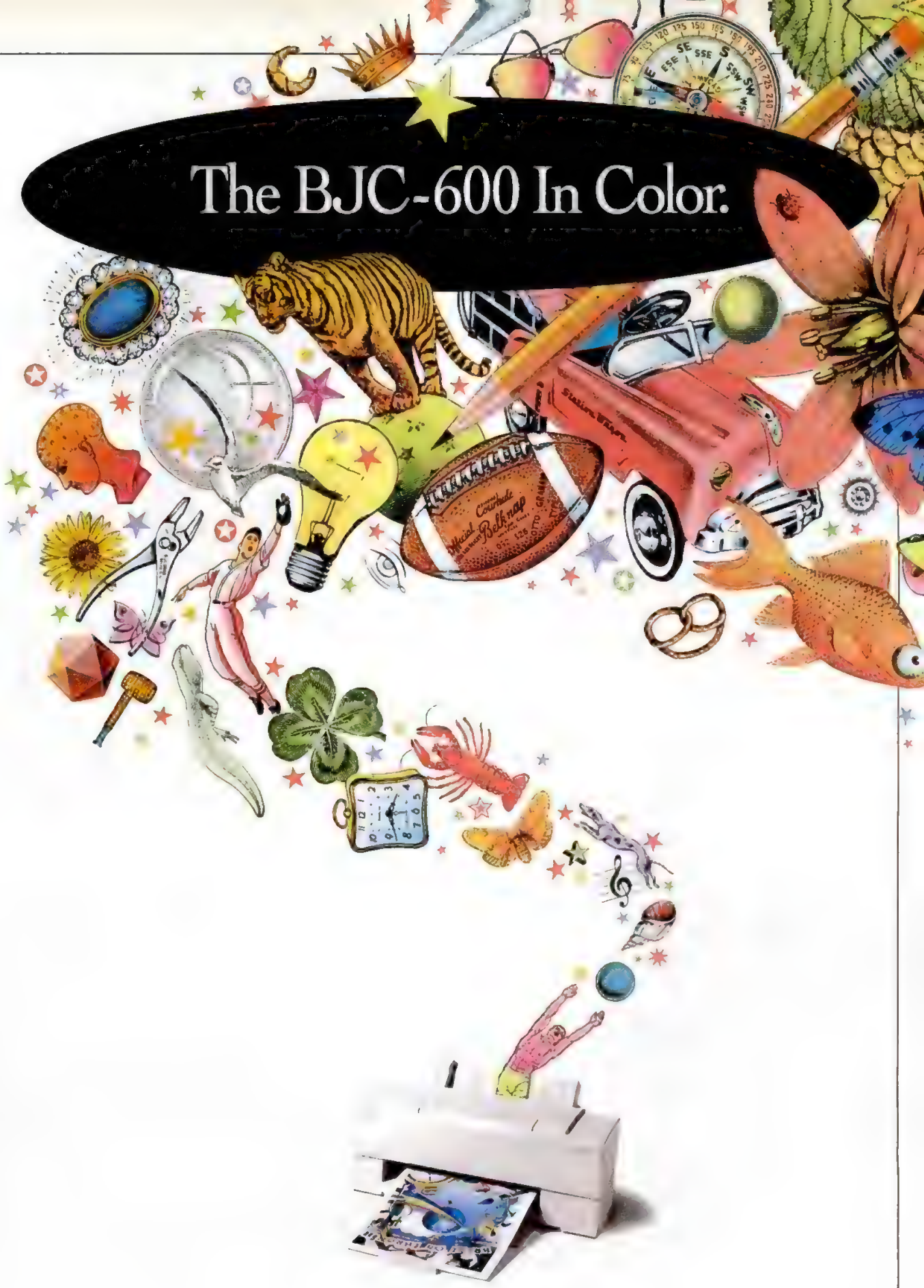
Finally, at less than $649*, the Canon BJC-600 color printer will save you money right from the start.

To get the name of your nearest Canon dealer, call 1-800-848-4123. Because now that you know the facts in black and white, it's time to see the BJC-600 in color.

Canon

*Dealer prices may vary, but most dealers sell the BJC-600 at prices under $649. © Canon Computer Systems, Inc. Canon and BJ are registered trademarks, and Bubble Jet is a trademark of Canon Inc. CCSI 2995 Redhill Ave., Costa Mesa, CA 92626. In Canada, call (800)387-1241.

The BJC-600 In Color.



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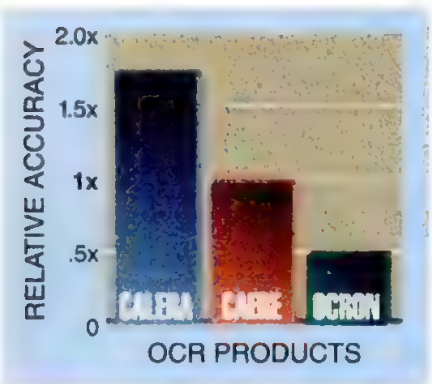
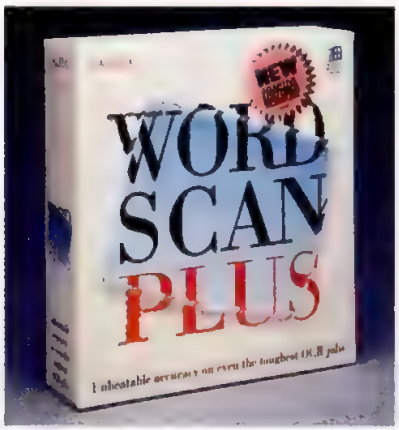


*From a test deck of 460 document pages, ranging from clean to very degraded, Calera tested two to three times more accurate than competitive products.**

Friendliness You'll Welcome

With WordScan Plus, you get an icon-based toolbar that takes full advantage of the user-friendly Windows operating environment you've come to appreciate. For support during OCR operations,



simply refer to the helpful tool bar with its exclusive HoverHelp™ feature. Just point to any icon with your mouse and get a clear, concise explanation about the selected function.

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* Source: U.S. Government-Sponsored Study, 1993.

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CIRCLE 341 ON READER SERVICE CARD

Michael J. Miller

There's Someone in My Software

Computers are supposed to make things easier, right? Then why do we spend so much time figuring out how to run each and every piece of software that we load on our computers? A relatively new concept may make things easier. Many of today's best new software packages are trying to be much more than just tools. They are designed to be Wizards, Experts, Advisors, Coaches, and Tutors.

Many of the new programs that come across my desk feature one or more of these software teachers. And like teachers in a classroom, they can show you how to perform a task. Unlike teachers, they are just as ready to do it for you (in some cases, even the speed of performance is at your discretion). In almost every case, these electronic educators go a lot farther than the on-line tutorials and help systems to which we're accustomed. But like real teachers, they do have their own personalities. Almost every software developer has its own name for these advanced help systems. And each one of these instructors works differently from the others. All of this tells you a lot about the orientation of both the developer and the program.

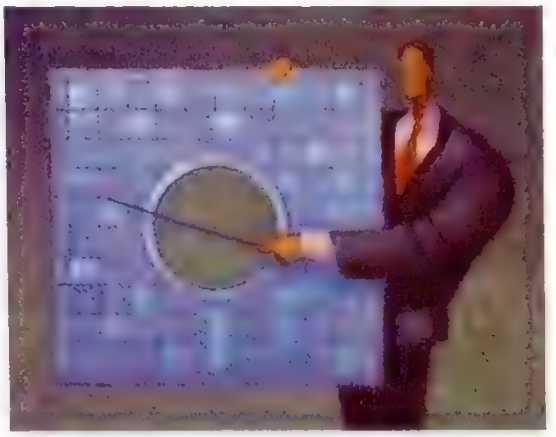
Microsoft sparked the trend with a series of Wizards that came with Microsoft Publisher 1.0, Microsoft Excel for Windows 4.0, and Microsoft Access. Eschewing the step-by-step tools approach found in most software, Wizards take a more task-oriented path to helping you get your work done.

The first such steps, such as the Chart Wizard and the Crosstab Report Wizard that come with Microsoft Excel 4.0, have been somewhat tentative. These Wizards take a fairly simple, straightforward task—creating a chart or crosstab—and do it for you. For instance, the Chart Wizard asks you to select a range, select a chart type, and answer a variety of other questions. Then it creates the chart for you. It does not really teach you how to use the menus and commands in the program; it just assumes you have a job to do, and so it helps you out.

These Wizards have since gotten more sophisticated. Publisher 2.0, for instance, includes a much wider set of far more sophisticated Wizards than its predecessor.

In Publisher 2.0, you choose from multiple Page Wizard Assistants that let you set up your document as a banner, business card, greeting card, newsletter, brochure, and so forth. These are much more than just templates. The Wizard gives you numerous choices such as overall design, placement of pictures, and page orientation, and then it creates the document for you. Dummy illustrations and text are also added, which double as instructions. For example, "This is the front cover" appears on the first page of your brochure and also serves as a dummy title text.

This Wizard doesn't really teach you how to do this on your own, but it sure does the work for you. Here in Publisher 2.0, and in Access, the Wizards are supplemented with Cue Cards that can, if you choose, remain on-screen and give you tips about what to do next. But for the basic functions, the approach is simple: Sit back and let the Wizard do its magic.



You may be tempted to polish some apples for the helping hands in your applications.

Illustration by Rob Colvin

WHAT'S IN A NAME?

Actually, the more you examine these digital teachers, the more you realize how aptly they've been named. For instance, the fundamental differences between a wizard and coach in "real" life parallel the differences in software. Wizards wave a wand and make things happen; coaches support you in your own efforts. WordPerfect Corp. has taken the latter approach and added a series of Coaches in WordPerfect 6.0 for DOS to the help functions, using native WordPerfect commands

to teach you how to do various tasks yourself—just like a real coach. Tasks range from the simple—making a text boldfaced—to the more complex—inserting hypertext links or making a table of contents. Each Coach walks you through the process of doing a task using your own data and WordPerfect commands.

For example, a Coach will walk you through the steps of marking text in your document for inclusion in a table of contents and then selecting the proper commands for creating the table. In many cases, these Coaches give you the option of letting them do the work for you or showing you how to do it. In the upcoming Quattro Pro for Windows 5.0, Borland International goes a step further, including *both* Experts and Tutors in the program.

Like Wizards, Experts help you create graphics, scenarios, and consolidations, and perform spreadsheet analysis. But Experts, as the name implies, are a bit smarter than Coaches, Tutors, or even Wizards. For instance, the Chart Expert not only walks you through the steps and creates a chart for you, it lets you add things like titles and axis labels along the way. At the same time, it shows exactly what the chart will look like before being placed in your spreadsheet. Like the real experts we so often rely on, the Expert even offers you an option of letting it choose the graph it thinks most appropriate for your data. I'm especially impressed by how easy the Analysis Experts make some often confusing functions, such as correlations between sets of variables.

The Experts do things for you, but Quattro Pro also comes with Interactive Tutors. These are the computer-based tutorials we're accustomed to seeing, showing how to do all the basics with a program's normal commands. Yet these introduce a major twist: They let you work with actual data in your spreadsheet, making it easier to learn how to use a program while actually getting work done. (And if there's a mistake, you just go back to where you were before starting the Tutor.)

TELL ME MORE

Of course, there are things you need to know when you're using software that don't really pertain to the software itself. That's something Software Publishing Corp. was clearly responding to when it created the Advisor in its new Harvard Graphics 2.0 for Windows. The Advisor, which optionally stays on-screen while you're working on a presentation, can display "Quick Tips" showing how to perform the most common tasks with the software. But it can also provide "Design Tips" showing how to make a better, more effective presentation. For instance, if you're editing a bullet chart, it will advise you to "use few words" and "avoid ALL CAPS" because they are harder to read. I've certainly seen enough examples of presentations gone amok to appreciate this. Not only do people need help in learning to use presentation packages, they usually need some good advice on creating better presentations.

Advisors, Experts, Tutors, Coaches, and Wizards: It sounds like the faculty of a great school. And why not? New computer programs are getting very sophisticated, but the point of computers is to make life easier. With these various teachers training us, and sometimes doing a bit of our grunt work as well, we might have more time to play hooky. □

CIRCLE 170 ON READER SERVICE CARD

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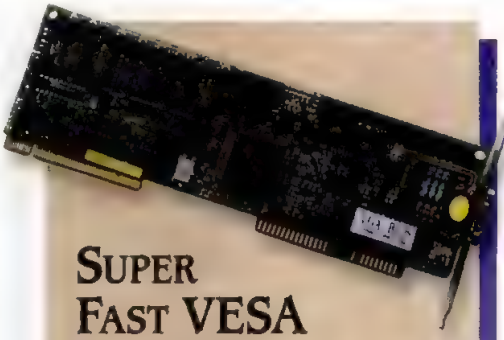

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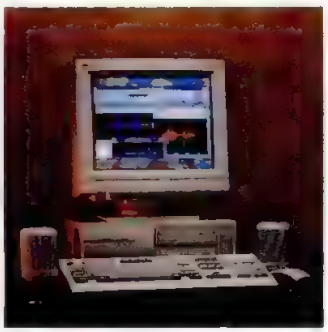

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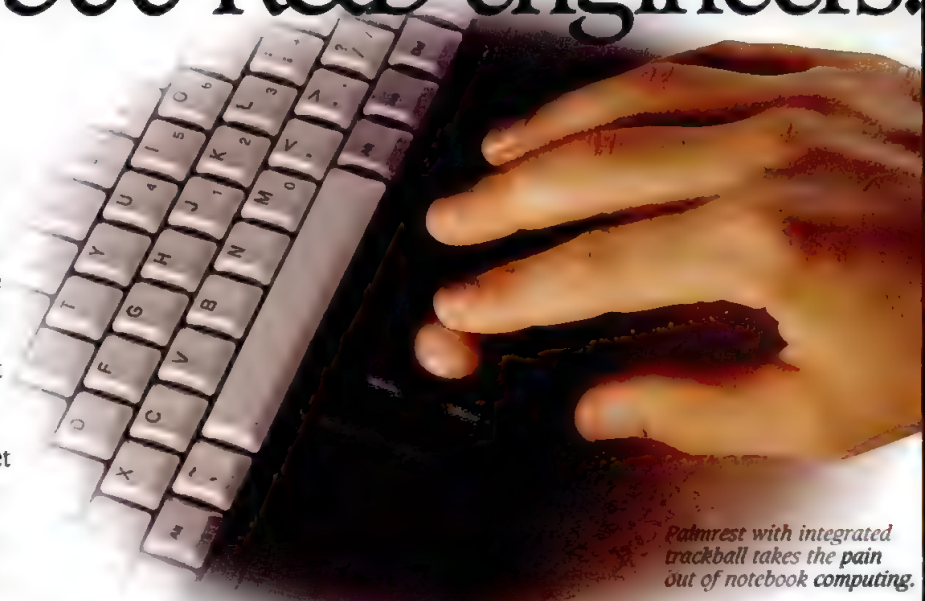

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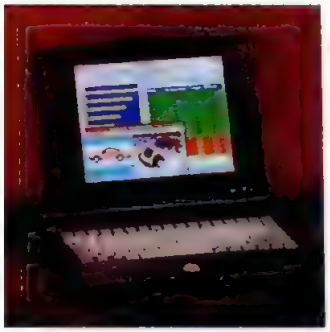

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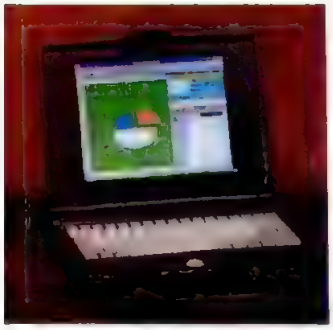

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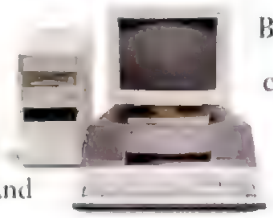

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CIRCLE 093 ON READER SERVICE CARD

Bill Machrone

The Six-Stringed Computer

What follows is sheer self-indulgence. I've just had one of the rarest of experiences, when my job (writing this column) happened to intersect with a personal interest (playing the guitar). I never in my wildest dreams thought that I'd be hooking an acoustic guitar to my PC.

That was before G-Vox, the product of a Philadelphia start-up, Lyrrus Inc. This innovative hardware/software combination attaches easily to your guitar and plugs into a serial port. It knows which notes you're playing on which string, and that opens up a world of possibilities. G-Vox starts with a pickup that mounts with suction cups onto the body of your guitar, close to the bridge. It only sounds kludgy: In truth, it's simple, and it doesn't damage your guitar's finish. The pickup connects to a small, flat box that contains all of the proprietary electronics. It has a clip on the back so you can wear it as a belt pack. The belt pack, in turn, plugs into your serial port.

You can use G-Vox on an electric guitar, too, but you have to use the provided pickup rather than the ones built into the guitar. The pickup brings out all six signals to the belt pack, while electric guitars merge the signals from individual strings into one output.

The utility software aids you in setting up your guitar. A bar graph shows the output from each string, and you can change the sensitivity thresholds, gain, and responsiveness string by string. Above the bar graph you see a depiction of the fretboard. As you finger melodies or play chords, dots appear that correspond to your finger positions. When it's properly set up, you can't outplay it, an amazing accomplishment. G-Vox also gives you an on-screen electronic tuner that brings each string into ideal pitch. This is a necessary step because G-Vox will decipher the notes you're playing far more quickly if they're in proper tune. Unlike some commercial electronic tuners, it lets you set the target note for each string, so you're not limited to standard tuning. You can keep favorite tunings in files and call them up as necessary. In practice, I found the tuner to be somewhat fussy and erratic. Unless you're hopelessly tone-deaf, you can probably tune your guitar well enough to suit G-Vox without it.

Get ready to jam with the ultimate alternate input device: your guitar.

THE FUN BEGINS

Once you're past the utilities, you get into the G-Vox applications. Riffs, those stylized flurries of notes, are what set the accomplished guitarist apart from the merely competent. G-Vox's Riffs application uses digitized recordings from talented, professional guitarists. You can play the riff at any speed, see the musical and tablature notation on the screen, and watch the fingering on the fretboard. Like many guitarists, I'm not all that good at reading music. The tablature is a big help, but hearing the riff and putting the sound together with the notation brings it all together for me. As in the Suzuki method for violin and other instruments, imitation brings quick and gratifying results. Also, the computer is far better than variable-speed tape recorders for learning riffs because the pitch doesn't change as you alter the speed. You can "follow the bouncing ball" in several different ways. One of the most useful for the beginner is the mode in which the ball only advances when you play the right note. Thus you can play the riff at slow speed, then slog through it, one note at a time. As you gain proficiency you can pick up speed with the metronome.

The Riffs application is the framework into which you plug libraries of various artists' licks. Lyrrus has signed up well-known

Illustration by Rob Colvin

The Green Monitor With A Big Screen From KFC

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Your best source for monitors is KFC, since our complete line from 9",14",15",17",20" & 21" monitor, advance function like full Screen, Pincushion, Trapezoid and Rotation Adjustment is also available, Allow you to do one stop sourcing efficiently. So there is no need to waste time calling different venders for different types of monitors. Just call KFC, and you are sure to find what you wants.

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CIRCLE 330 ON READER SERVICE CARD

talents such as Steve Morse, Carl Verheyen, and Adrian Legg. Along with each artist's playing, you get several screens of tips and techniques. These words of wisdom deal with topics such as style, practicing, and playing with others. They help you appreciate the underlying musicianship.

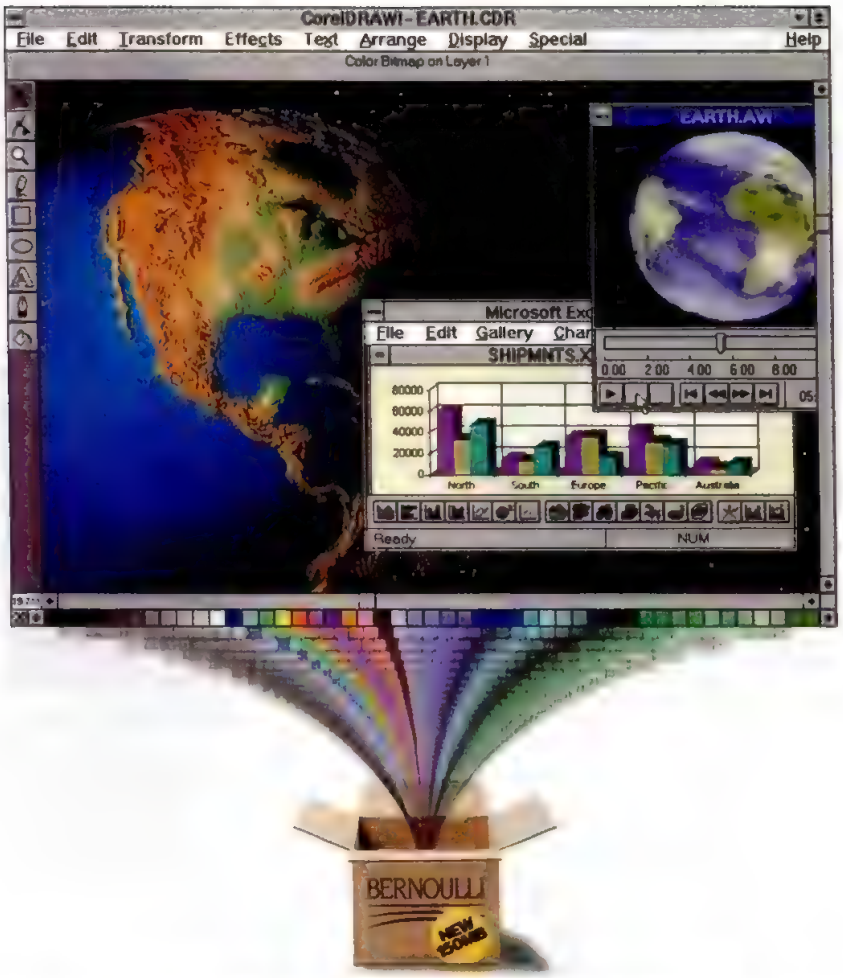
Another optional application, Chords, analyzes the chords you play, and can not only tell you the proper name for a particular fingering that's always sounded good to you, but can show you a number of inversions and options for playing the same chord elsewhere on the neck. Chords also has a chord guessing game and lets you print custom chord dictionaries and lead sheets.

Tour is an optional game that takes the sting out of practice. In one wry mode, you're a street musician, and the audience is throwing produce at you. Each piece of fruit has a note on it; if you play the note in time, it disappears and advances your score. If you're slow, splat! Talk about paying your dues! Another mode is a beat-the-clock race to play as many correct notes as possible in the least amount of time.

Finally, if you're an electronic musician and you want to combine your guitar skills with the world of Musical Instrument Digital Interface (MIDI), you can add the G-Vox MIDI module. It takes your notes and turns them into MIDI events. From there, your imagination is the limit. You can make your guitar sound like a pipe organ, raindrops, voices, or things that have never before been heard.

Me? I've got a MIDI synthesizer at home, but I vastly prefer the wonderful resonances of wood and steel to techno-pop sound effects. I appreciate the long hours of hardware and software engineering that Lyrrus has put into G-Vox; it can make me a better player in ways that no audio or video tape can match. Since it would take a couple of thousand dollars' worth of MIDI equipment to duplicate what G-Vox does, the $400 price range is not out of line.

G-Vox is an admirable technical breakthrough, but this young company has thought beyond the technological wizardry to the needs of amateur musicians. The applications are just the right thing whether you're a budding guitarist, you want to increase your proficiency, or you've decided to move into new musical styles. You can reach Lyrrus at 215-922-0880. □



Windows users are opening up a new world of possibilities.

The new Bernoulli® 150. Get increased performance with fast cache built in.

Now, get a free 90 or 150MB disk when you buy the Bernoulli 90 or high-performance 150 Insider, Transportable or Dual drive.

Ah, the things you can do with software these days. Amazing, isn't it?

That's why we created the new Bernoulli 150 removable drive. So you can get more out of your storage than ever before—more freedom. More excitement. And frankly, more storage.

With the new Bernoulli, you'll get a free 150MB disk included with your drive. So you can explore new ideas without running out of space. Then just add inexpensive disks as you need them—in 150, 105, 90, 65 or 35MB sizes. That's what we call MultiDisk™, a feature you can only get with the Bernoulli 150.

What's more, you can take your data where you need it, when you need it. Free from worry.

And since no one has time to sit on their hands, we've included new 256KB fast cache firmware for even better performance.

As you might have guessed, only award-winning Bernoulli Drives give you this much potential.

Call 1-800-846-2445.

Or visit your local dealer. And from now on, expect the world out of your storage.

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Makers of Bernoulli

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CIRCLE 378 ON READER SERVICE CARD

Best Pointing Devices.

"BUILT-IN POINTING DEVICES *vary in comfort and ease of use from the Apple PowerBook's large, front-mounted device to many smaller and less useful ones.* **IBM's TrackPoint II** *and* **Micro Electronics'** *small, front-mounted trackball were* **the best."**

PC Magazine, Cover Story, Portable PCs, August, 1993

Presenting an amazing deal on the IBM PS/Note™. We've teamed the quality and reliability from IBM® with added features and a price breakthrough that only Micro Electronics™ can deliver.

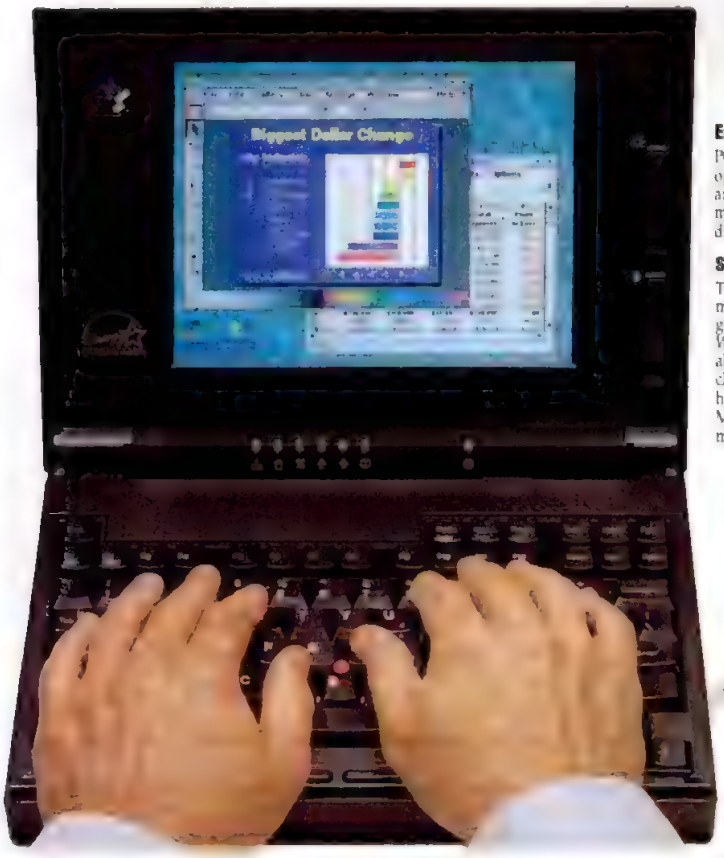
Small and lightweight, the PS/Note operates with the Intel 486 SL processor and has the power to run demanding business software. A larger, 170MB hard drive, 4MB RAM, included fax modem and added PCMCIA capabilities give you the features you want—all at a special price. Plus, the PS/Note comes loaded with popular software and bundled extras!

Your PS/Note is backed by IBM service and support. Rigorously tested and retested—your PS/Note is guaranteed to meet IBM's high quality standards.

Don't miss this special offer. Act now!

The renowned TrackPoint II™ integrated pointing device

IBM®



Exclusive Micro Electronics Features

Easy add-ons with PCMCIA

PCMCIA capabilities give you options for future expansion and technology. Additional memory, adapters, and hard drives are easy to install.

Superior battery life!

The advanced power management hardware and software give you a longer battery life. With power management enabled, you can run the monochrome PS/Note for up to five hours with the NiMH 2200 MA batteries. And there's no memory effect.

The IBM PS/Note

A larger 170MB hard drive and built-in fax modem included! Plus:

- an Intel 486 SL/25MHz processor
- 4MB RAM expandable up to 20MB RAM
- 8k internal cache
- a built-in 1.44MB 3.5" floppy drive
- and a personalized nameplate.

Receive free, preloaded software with your PS/Note —worth hundreds of dollars!

- MS-DOS 6.0.
- Microsoft Windows 3.1.
- PRODIGY.
- America On-line, PS/1 edition.
- PS/1 Fitness Index and Tutorial.
- plus your choice of Quicken, WinFax Lite or Calendar Creator Plus.

A keyboard with full-size keys—familiar to the touch

The PS/Note features an exceptional full-size 85-key keyboard with the unique TrackPoint II pointing device. Control cursor movements with ease by moving and varying pressure on the eraser-like button.

Serial, parallel, VGA, and PS/2 keyboard/PS/2 mouse ports

intel inside

Monochrome	STN Color
$2199	$2899

- 486 SL/25MHz
- 4MB RAM
- 170MB HD
- DOS, Windows & more
- PCMCIA type II slot
- Fax modem included!

Your satisfaction is unconditionally guaranteed for 30 days from date of purchase. If for any reason whatsoever you are not satisfied with your purchase from us, we want you to return it.

Order today and also receive over $4000 in discounts!

"Thank-You's from PS/Note" gives you discounts on travel, software and more! Offer expires 12/31/93

Convenient payment options

Use your MasterCard, VISA, Discover Card, personal check or P.O. with credit approval.

Thank-you for your order!

Service, warranty and support

- One-year limited warranty with toll-free Express Maintenance
- 30-day unconditional money back guarantee
- On-line technical support for the life of the computer.

Micro Electronics
a division of MEI/Micro Center, Inc

Specifications

Size/Weight
- 11.7" X 8.3" X 1.9"
- Monochrome: 5.2 lbs. with battery
- Color: 5.8 lbs. with battery

Pointing Device
- TrackPoint II

Battery
- Monochrome: up to 5 hours with power management
- Color: up to 3 hours with power management
- NiMH (no memory effect)
- 2.2 AmpHours
- Universal AC Adapter
- Quick 1-hour recharge when not in use

Advanced Power Management
- Power management hardware and software (nearly transparent to user) for longer battery life
- Automatic and manual suspend/resume button
- Integrated logic and power system planar
- Internal variable-rate charging system

Processor and Memory
- Intel 486 SL 25MHz CPU
- 4MB RAM (expandable to 20MB)
- 8k internal cache

Drives
- One built-in 1.44MB 3.5" floppy drive
- Removable internal 170MB hard drive

Software
- Comes with MS-DOS 6.0, Microsoft Windows 3.1, Microsoft Works for Windows, PRODIGY, America On-line (PS/1 Edition), PS/1 Tutorial, PS/1 Index, PS/1 Fitness, and choice of Quicken, WinFax Lite or Calendar Creator Plus

Display
- 1024 x 768 for external monitor with 512k video RAM
- Monochrome: super-twisted 64 grayscale, 9.5" LCD
- Color: 256 colorscale 9.2" STN color
- Adjustable contrast and brightness

Keyboard
- Full-function keyboard with 85 keys and 4 inverted-T cursor control keys

Modem
- Fax-9600 baud send/4800 baud receive/2400 baud modem

I/O Ports
- Serial, enhanced parallel, VGA, PS/2 keyboard/PS/2 mouse
- PCMCIA 2.0 slot

30-day, unconditional money-back guarantee

Call 1-800-468-2308 to order today!

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Best Notebook Values.

"Scoring high in overall value and design, the Micro Electronic's WinBook gives you a lot for your money, including an outstanding integral trackball."

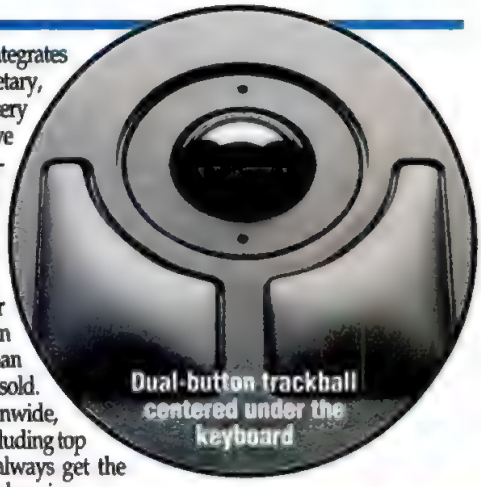
PC MAGAZINE, Portable Computing Issue, August, 1993

The WinBook by Micro Electronics™ gives you the power to run Windows and a unique, ergonomic design to make it easier to use.

It features a built-in, centered trackball which allows you to control cursor movements effortlessly without having to lift a single finger off the keyboard. Full-size keys and a sloping hand rest let you work in total comfort.

The new, upgradable, fully-static design SL enhanced Intel486SX 25MHz chip enables the CPU to operate at a 0MHz low power state. The WinBook's Pico Power Evergreen chipset integrates battery and power management with a proprietary, open loop heat regulator circuit to extend battery life and prevent heat build-up. Plus, we have fine-tuned the WinBook's screen. In monochrome and in dual-scan STN color—you get sharper, clearer images with less cursor loss.

The WinBook was engineered for Micro Electronics, a division of MEI/Micro Center, Inc. MEI is America's leading direct source for computer products. Micro Center has been selling PCs for more than 14 years—longer than IBM or Compaq—with over 736,000 units sold. With over 2.2 million satisfied customers nationwide, we have developed a superior support staff including top engineers and technical specialists. So you always get the highest quality product at the lowest possible price.



WinBook™

WinBook 486 SX Features

Ergonomically engineered

The WinBook's ergonomic features include a sloping hand rest and keyboard, plus a centered dual-button trackball—allowing you to work in total comfort away from your desk.

Clear, sharp color display

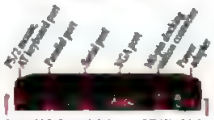
The WinBook's advanced, dual-scan color display gives you 99% shadow-free performance compared to other single-scan passive matrix displays. You get near active matrix quality at a passive matrix price!

NEW! Intel486 SX SL Enhanced intel inside

The 5.4 lb. WinBook, designed by award-winning Palo Alto Design

- Includes a 9600 baud send 4800 baud receive fax/2400 baud modem.
- Fast-acting, LCD screen for less cursor loss.
- Industry-standard PCMCIA 2.0 slot for future expandability.
- 512k video RAM.

Mouse/keyboard, parallel, serial & VGA ports plus PCMCIA expansion



Docking station gives you desktop power

With the available docking station, your WinBook instantly becomes a full-function desktop computer. The two expansion slots and drive bays allow you to add peripherals such as monitors, hard drives, CD ROMs, I/O cards or an extended keyboard. It also includes parallel, serial, PS/2 mouse, external keyboard and VGA ports. **And it's just $399!**

Longer battery life

The WinBook features NiMH 2200 MA batteries with gold-plated contacts. This allows it to run much longer than units with traditional NiCAD batteries—and there's no memory effect.

Monochrome	Dual-Scan Color
$1699	$2399
4MB RAM 120MB HDD	4MB RAM 200MB HDD

- Intel486 SX 25MHz
- DOS & Windows
- Fax modem included!

Act now for a special offer!

HEWLETT PACKARD

The HP DeskJet Portable printer weighs only 4.7 pounds and uses the same inkjet technology as other DeskJet models. At only $299* including battery, you can't afford to miss this offer!

$299*

*$299 after $75 mail-in rebate. For more information, call 1-800-468-0878

Your satisfaction is unconditionally guaranteed for 30 days from date of purchase. If for any reason whatsoever you are not satisfied with your purchase from us, we want you to return it. We will be glad to repair the product or give you your money back.

Service, warranty and support

- 72-hour service turnaround guarantee.
- 30-day unconditional money-back guarantee.
- 24-hour burn-in protection.
- One-year limited warranty on parts and labor.
- Toll-free technical support for the life of the computer.

Convenient payment options

Use your MasterCard, VISA, Discover Card, personal check or P.O. with credit approval.

Thank you for your order!

Micro Electronics
a division of MEI/Micro Center, Inc

Specifications

Size/Weight
- 11" X 8 3/4" X 1 3/4"
- 5.4 lbs. with battery (monochrome)
- 5.9 lbs. with battery (dual-scan color)

Pointing Device
- 16mm Alps dual-action, Microsoft- compatible trackball

Battery
- Up to 3 hours with power management, over 5 hours with auxiliary battery (less 30 minutes for color)
- NiMH (no memory effect)
- 2200 MA with gold-plated contacts
- Worldwide auto-sensing AC adapter
- Quick 1.5-hour recharge

Processor and Memory
- SL enhanced Intel486 SX 25MHz CPU
- 4MB RAM
- Pico Power Evergreen HV chipset
- 8k internal cache

Drives
- One built-in 1.44MB 3.5" floppy drive
- Monochrome: Internal 120MB (15ms) hard drive
- Color: Internal 200MB (16ms) hard drive

Software
- Comes loaded with MS-DOS 6.0 and Microsoft Windows 3.1

Display
- Super-twisted 64 gray-scale, 10" LCD and 1024 x 768 fox external monitor with 512k video RAM
- Optional dual-scan STN color display
- Adjustable contrast and brightness
- Visible LED indicator on cover-down

Keyboard
- Full-function keyboard with 85 keys and 4 inverted-T cursor control keys, 3.0mm keyboard spacing

Modem
- Fax-9600 baud send/4800 baud receive/2400 baud modem

I/O Ports
- PS/2 mouse interface/AT keyboard interface
- PCMCIA 2.0 slot
- Serial: 9-pin connector
- Parallel port
- Video: 15-pin connector for CRT
- 160-pin docking station
- Auxiliary battery port

Options
- 486 DX 33MHz CPU on selected models
- Docking station

30-day, unconditional money-back guarantee

Call 1-800-468-0878 to order today!

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CIRCLE 085 ON READER SERVICE CARD

The ZEOS® ColorNote™ 486.

Incomparable Color, Unbelievable Value!

Standard with every ColorNote 486:

- 33MHz 486SX Intel CPU.
- RAM expandable to 20MB.
- IDE hard drive expandable to 170MB.
- 8K internal cache.
- Internal 3.5" 1.44MB floppy disk drive.
- PCMCIA slot supporting a type I, II or III device.
- 512K video RAM.
- Local bus video for super-fast 33MHz performance.
- Display: 640 x 480 dual scan color VGA backlit LCD, 9.4" diagonal, up to 256 colors.
- Supports an external SVGA color monitor at resolutions up to 1024 x 768, 16 colors or 800 x 600, 256 colors.
- 82-key keyboard with embedded numeric keypad and 12 dedicated function keys.
- Built-in trackball.
- Replaceable and rechargeable NiMH battery.
- One serial port, parallel port, keyboard port, mouse port and external video port.
- Full power management features include Low Power mode and programmable Stand-by features.
- AC adapter with full range from AC110-240V to DC.
- 8.54" x 11.65" x 1.5"; 5.6 lbs.
- FCC Certified Class B; UL Listed.
- Complete ZEOS Customer Satisfaction Package.

ZEOS's new ColorNote 486 starts with a powerful, reliable Intel 486SX processor operating at 33MHz—not just 25MHz like many other color notebooks. And we added local bus video for super-fast 33MHz video performance. We've packed in enough power and memory to easily run Windows: 4MB RAM (expandable to 20MB), an 80, 120 or 170MB hard drive, and an 8K built-in cache—standard.

COLOR JUST LIKE A GREAT DESKTOP MONITOR.

For a crisp, vibrant color VGA display, the ColorNote employs a new technological breakthrough—dual scan technology—for color that's much better than standard passive matrix, yet not as expensive as active matrix. You get color that's comparable to that of a great desktop color monitor! What's more, your screen is backlit, 9.4 inches on the diagonal, and gives you up to 256 colors.

PLENTY OF POWER—PLUS A PCMCIA SLOT!

Color technology can drain a notebook's power. So that you can get up to three hours—and beyond—of battery life, the ColorNote uses a Nickel-Metal Hydride battery. It also comes equipped with an internal 1.44MB floppy drive and PCMCIA slot. All this—and the ColorNote weighs a mere 5.6 pounds, including the battery!

AWARD-WINNING SERVICE & SUPPORT.

We're the only company to win *PC Magazine's* Readers' Choice for Service and Reliability—for both desktops and notebooks—*twice!*

TOLL-FREE TECH SUPPORT AT ANY HOUR.

We're here for you 24 hours a day, 365 days a year, and always a toll-free phone call away.

WARRANTIES & GUARANTEES.

All ZEOS systems come with a One Year Limited Warranty and a 30-Day Money-Back Guarantee. You're going to be very satisfied. *We guarantee it!*

In ordinary passive matrix displays (inset photo), colors are less saturated, and fading at the edges is common. With dual scan technology (on screen), color is richer, more uniform—with quality comparable to a great desktop monitor.

PACKAGE 1

ColorNote 486: $2395

- 4MB RAM
- 80MB IDE hard drive

PACKAGE 2

ColorNote 486: $2695

- 4MB RAM
- 120MB IDE hard drive
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

PACKAGE 3

ColorNote 486: $2995

- 8MB RAM
- 170MB IDE hard drive
- Custom leather carrying case
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

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ZEOS INTERNATIONAL, LTD.

CIRCLE 038 ON READER SERVICE CARD

John C. Dvorak

Superstores Are *Not* Super

If you think computer superstores are all they're cracked up to be, then you haven't read the report, "Who's Buying at Retail." In it you'll discover that half the people going into a superstore can't even find the items they want. In my opinion, these stores are not doing their job.

The report, done by Directions for Decisions as part of research financed by Ziff-Davis Publishing and InfoCorp, studied to death the buyers who frequent computer superstores, office products superstores, and consumer electronics stores.

Before I start to complain, let's look at some interesting facts. It's generally known that the computer geek population is about 90 percent men and (maybe) 10 percent women. According to the report, 83 percent of computer superstore shoppers are males and 17 percent are females. At office products superstores, the ratio is 68/32, and at consumer electronics stores it's 72/28.

What do these numbers reveal? I suspect that a lot of women are into computers, but they're embarrassed by it! They avoid the computer store and instead go to office products stores and electronics stores. So if a friend sees them, they can say they were buying a stapler or some blank tapes for the VCR. Whatever the case, this needs further study.

Other interesting factoids: The median age of storegoers is between 37 and 41; 62 to 66 percent are college grads; median household income varies from $55,500 for the office products superstore shopper to $65,700 for the computer superstore shopper. And 83 to 93 percent of the surveyed shoppers use computers in their homes, which, I believe, is a higher number than any of us imagined.

The report finally gets to a sore point with me: These stores don't do their job. On table 48 is a breakdown titled "Reasons for not buying specific PC products planned to buy." For microcomputer systems, the main reason shoppers didn't buy was that they were comparison shopping. This isn't surprising; the selection of computers is usually limited to a few brands. For peripherals, the reason was the same, except the excuse "Store did not have item wanted" jumped to 29 percent at computer superstores. Almost a third could not find an item they wanted. For computer supplies and accessories, 36 percent of shoppers at office products stores and 38 percent at consumer electronics stores said the store did not have the product they wanted. The computer superstores topped them both with a whopping 48 percent. This pathetic number also plagued the software category: Computer superstores hit 46 percent failure, office products stores managed 49 percent, and consumer electronics earned 33 percent.

Now, I never think of an office products store or a consumer electronics store as a place to find software. But wouldn't you think a computer superstore should satisfy more than just half the shoppers? In fact these so-called superstores have a mediocre selection of just about everything. Just look at the selection of modems. *What* selection!? There are lots of boxes in these stores because inventory is on the floor. But the boxes are filled with the same few items.

Got the itch to buy? Take my advice and skip the superstore. Chances are you won't find what you want.

I've been reluctant to pick on these big stores. I've been hoping they'd improve and do a better job than the small chains have done. But I've visited store after store, and I've not been impressed. These computer superstores are not *superstores* in any sense of the word. They're just big versions of small stores with a limited selection of products stacked a mile high.

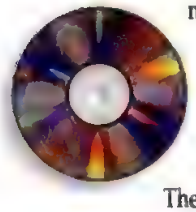
As for shopping, I've had better experiences perusing the want ads. This report confirmed my suspicions. It's time to complain.

Illustration by Rob Colvin

HOW TO BUY A DOUBLE-SPEED CD-ROM... WITHOUT GETTING TAKEN FOR A DRIVE.

Introducing Creative OmniCD.

If you've been thinking about adding the power and excitement of an internal CD-ROM to your PC, here's some great news: thanks to our exclusive Creative Double-Speed Technology,™ *double-speed CD-ROM performance is now available at about the same price you'd expect to pay for a single-speed drive.*



And we're not talking about just any CD-ROM here. This is a full-featured, MPC 2 compliant, XA-ready, 300KB/second, multi-session photo CD drive with a blistering fast 320ms access time: The all-new Creative OmniCD.™

WORKS WITH ANY SOUND CARD.

Of course Creative OmniCD works with your Sound Blaster™—after all, it is the industry standard for PC audio. But what if you've already got another sound card?

No problem. Because *Creative OmniCD works perfectly with just about every major brand of audio card*...or even *without* a sound card for applications that don't use audio.

Best of all, Creative OmniCD opens up a whole new world of CD-ROM applications. Like photo CD—we've even included Aldus® Photostyler™SE image enhancing software right in the box. And also games, multimedia and business applications, education, and more.

THE BOTTOM LINE: A LOT MORE DRIVE, A LOT LESS MONEY.

Sure, there's plenty of other manufacturers offering double-speed CD-ROM drives. But as part of a complete package *with an SRP of less than four hundred dollars?** Now *that's* Creative.

For more information and the name of your nearest Creative Labs dealer, call 1-800-998-5227.

Sound BLASTER™ CREATIVE™ CREATIVE LABS, INC.

PC2 Multimedia PC

*SRP $399.95

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CIRCLE 086 ON READER SERVICE CARD

John C. Dvorak

Inside Track

When Will It End Dept.: Researchers at IBM's disk drive plant in San Jose claim they've discovered a **magnetic anomaly** that may well **increase** the storage capacity of hard disks by a factor of 30! It's possible that within the next decade a **250- to 300-gigabyte** hard disk will be commonplace on the desktop! So much for compression worries. "Sickened about space on your 250GB hard disk? Use Stacker, Version 50, and get 500GB on those old drives!"

IBM researchers have found a magnetic anomaly that may double hard-disk capacity every year and a half. That could give us 1.15-terabyte hard disks by the year 2008.

According to IBM, disk capacity has historically had a growth rate of about 30 percent compounded annually. With the introduction of the magnetoresistive head technology, this has increased to a 60 percent compound annual growth rate or a **capacity doubling** every year and a half. This new development, which IBM calls "Giant Magnetoresistance," may quicken things even more. Just do the math. If we start at a gigabyte today and grow it at a 60 percent rate, then we'll end up with 1.15-**terabyte** hard disks in the year 2008. Hmmm, that means I'll need **over 14,000 QIC 80 tapes** for backup. Help!

They Come in Bunches Dept.: Over the years I've postulated that products are dreamed up at the behest of the societal collective unconscious by many people simultaneously. These products are then released into the market at about the same time. This process is always the result of some "other" new development. I call it **invention triggering.** Each inventor thinks the other guys are copycats or **thieves.** One idea floating around has finally arrived, and I expect to see a **deluge of similar products,** probably those killer apps everyone wants to discover. Three elements were required to trigger the invention process: good character recognition, cheap scanning, and inexpensive, high-capacity hard disks. The product is a business-card scanner/reader/database. While a lot of people have "secretly" told me they're working on one, CypherTech of Sunnyvale (408-734-8765) has the first.

Called the CypherScan, this is a product that will sell millions of copies. **I need this product!** Everyone needs one. It scans a business card, reads the information via OCR, stores it into a database, and saves an image of the card. My business card collection is **totally out of control.** I hope this helps.

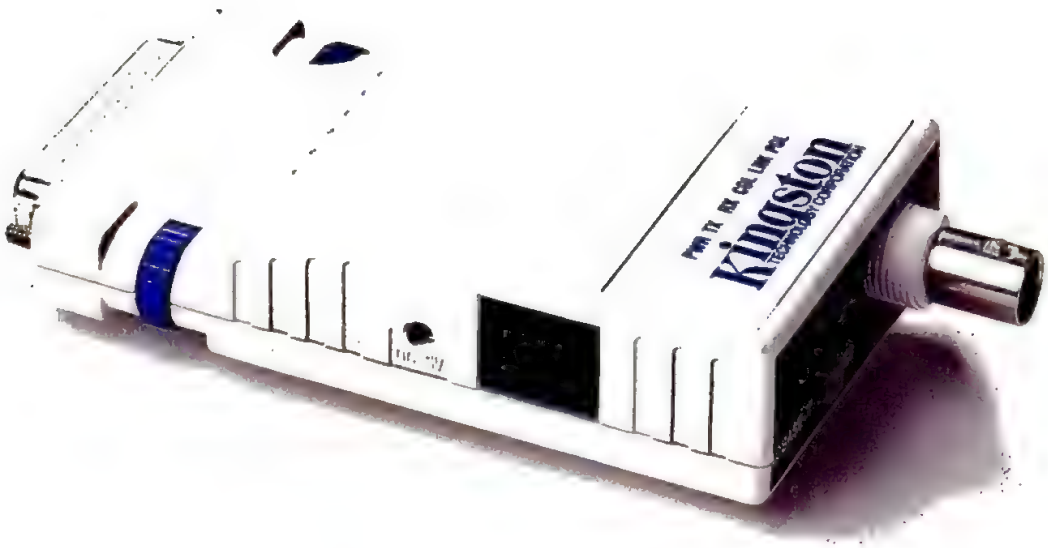
We Get Letters Dept.: Over MCI Mail comes this message from Todd Natkin. Subject: DRAM Prices. *Hi, John. I hope you don't fall into the knee-jerk trap that most columnists have—that the epoxy shortage will hurt Win NT sales. It seems to me if I were building DRAM SIMMs and had a limited amount of epoxy, I'd be using it to build 16MB SIMMs rather than 1MB or 4MB ones. In other words, the shortage likely means that manufacturing capacity will switch to 16MB SIMMs faster and* [perhaps by the end of the year] *actually result in lower prices for high-performance 16MB systems.*

There's been a lot of chitchat about the Sumitomo Chemical epoxy plant in Japan that **blew** sky high and **screwed** up the major supply of an important epoxy used in the making of chips. The **gossip channels went ballistic.** The plant wasn't going to be rebuilt. It *was* going to be rebuilt. It *wasn't.* It *was.* The supply is a couple of weeks. A couple of *months.* There are substitutes. There are *no* substitutes.

This is the way it shakes out. There will be a minor **shortage** just before (gulp) Christmas! Meanwhile, some hoarders may make some money and memory prices will rise, then **tumble fast.** Will it affect the sales of NT? You bet! I recommend **32MB RAM for an NT system.** That combined with the lackluster performance of NT will slow sales until things break free next year. Oooops! My knee is jerking.

Good News and Bad News Dept.: First, the bad news. Memphis State University Assistant Professors Rick Fischer and Elinor Grusin published an article in the Winter 1993 edition of *Journalism Educator.* Entitled "Grammar Checkers—Programs That May Not Enhance Learning," it concludes that **grammar checkers are useless** at the college level in helping students learn grammar. Using two groups of students (one equipped with grammar-checking software and the other not equipped with the software), the professors drew two conclusions. First, there was "no difference in grammar knowledge between groups at the end of the semester." Second, "the group that used the grammar checker was **less satisfied** with the course than those where no grammar checker was available." The grammar checker also flunked a test given to students wanting to become journalism majors. Not wanting to **condemn** all grammar checkers (why not?), I should mention that the professors used Grammatik, the industry's standard grammar checker. Uh oh.

Now the good news: That's **all** the bad news there is! □



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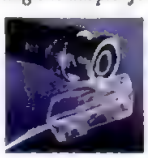

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Jim Seymour

Misunderstanding the Pentium

Look, we blew it. We got it wrong. We misunderstood, and now we look silly. By "we," I mean almost the whole PC industry. And by "it," I mean the best use of Intel Corp.'s new Pentium chip.

For the past year, the computer and businesspress have been filled with fulsome praise for the Pentium. "Newest," "fastest," "hottest," "mainframe-on-your-desk," etc., etc. And almost always, in tandem with those raves were stern and unambiguous comments about how the main use of the Pentium chip for the first year or so would be in servers, not desktop PCs.

Servers, the comments ran, were, of course, where that power was most needed. In fact, the question would quickly move from "486 or Pentium?" to "How *many* Pentiums?" because of servers' unquenchable taste for power; multiprocessor Pentium servers, running new network operating systems that would use those staggering system resources wisely, would soon be taking over.

This meant the Pentium would show up in desktop PCs (oops, make that "workstations," the phrase we use *sotto voce* when we mean really powerful desktop PCs) much later, after the demand for Pentium-equipped servers was satisfied. It surely wouldn't hurt just to wait for the eventual arrival of Pentium on desktop PCs, where such power wouldn't really be needed.

Not! That was EXACTLY BACKWARDS! And if the computer industry had been reading its own clippings, everyone would have realized that.

Because for years, many of us have been screaming for what we *really* need in LAN servers: better I/O, more throughput. We have enough CPU power in servers today. What we need is faster data pumps: a faster and wider bus, faster network interface cards, and smarter caching—not faster CPUs.

Then came the defining event of 1993, the Interop trade show, which whacked PC coordinators, IT/IS managers, PC hardware vendors—and writers, columnists, and editors—upside the head.

At Interop, Compaq and Novell had 1,000 PCs running under NetWare 4.0 on a single 66-MHz 486DX2-based Compaq Systempro server. Guess what? The Systempro's CPU never exceeded 42 percent saturation—in other words, less than half its capacity. So we need to run right out and buy Pentiums for our servers, huh?

Not only did we get that half of the equation wrong, we got the other side wrong too: We need all the power we can get on the desktop today. Not everyone needs a Pentium-class desktop machine: A lot of us will continue to work happily with fast 486s for years to come; but for many true power users, a faster desktop PC is the right decision.

But when? And which?

This year's double-clutching with two-speed Pentiums has confused buyers. You can buy a machine with a 60-MHz Pentium or a 66-MHz Pentium. The latter's obviously faster, eh? Nope. Good system design raises its head here: You can find 60-MHz PCs that outperform 66-MHzs.

You may think of Pentium-based PCs as servers only, but you really need the power on your desk.

Now, Intel's about to confuse us with more enticing choices. There's early 1994's clock-doubling Pentium, which will run at 100 MHz internally, 50 MHz when it speaks to the outer world. And look for the long-promised clock-*tripled* 486/DX3, running at 100 MHz internally and 33 MHz externally, in new PCs this fall.

Buy now or wait for those to hit?

And what will happen to existing 486 chips? To the current Pentiums?

If you don't find the answer obvious, you're in good company. How these

Illustration by Rob Colvin

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chips and PCs will fit into the pricing of the Intel x86 architecture has been a hot topic all summer. Even Intel people can't agree among themselves: I believe them when they trot out three or four possible scenarios for me and then add that Intel itself doesn't know yet which will apply.

Given our record on prescribing the original Pentiums as servers only, you'd be justified in taking a pound or two of salt with anyone's recommendations on the CPU futures market. But here's my guess.

I expect the 486 clock-triplers to push current midrange and high-end 486DX2s rapidly down the price/power curve. I look to the 486DX2/66 as the emerging mainstream processor of choice. (Actually, I think it's there now, but upcoming price adjustments will secure it even more firmly as the mainstream choice.) And the 486DXs, especially the obviously redundant 486DX/50, are not long for this world.

The clock-doubled 100-MHz Pentium will quickly claim the top of the x86 market but will face hot competition from the new Power PC chips. Intel will probably leave the current 66-MHz Pentium in the line for a while, but not for a long or happy life. The 66-MHz Pentium is too difficult and expensive to build; Intel would love to dump it and shift to the redesigned clock-doubled Pentium line as soon as it can.

Translated into "What do I buy, and when?" advice, 486DX2/66 PCs are about to become even bigger bargains than they are now; by Christmas, 486DX3s will be the hot machines; and by sometime next spring, the barn-burning, clock-doubled Pentium machines are going to be edging into quantity deliveries. And I'll be near the head of the line of early buyers.

I feel very comfortable these days telling corporate clients to stick to fast DX2s this fall and well into next year as mainstream office-automation machines. Those buyers will be riding the price curve down, in the PC industry's version of Wall Street's dollar-cost averaging.

Meanwhile, I advise them, tell your power-hungry people they'll be happier waiting a few months and not jumping to today's Pentium machines. Whether they choose a clock-tripled 486DX3 or shoot for the moon on a clock-doubled 100-MHz Pentium box next year, they'll be happier avoiding one of today's Pentium PCs and ducking an acute case of *wish-I-haddas*. □

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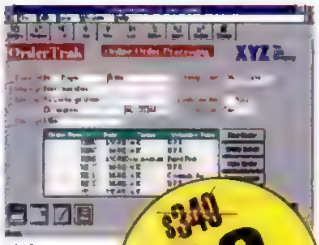

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Bill Howard

What's Wrong with Sound Boards

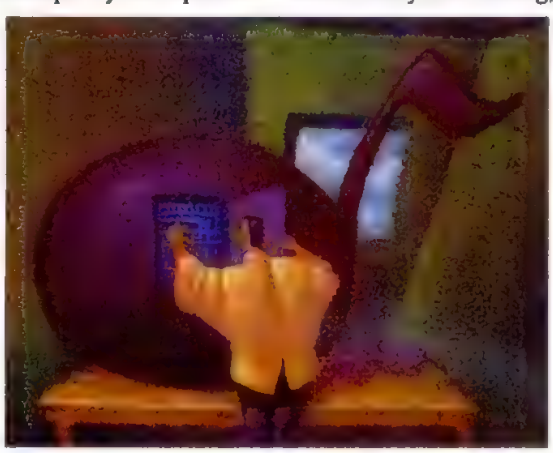
You've just spent $700 for a 16-bit sound board, a CD-ROM drive, and a pair of shielded loudspeakers. You've spent the kind of money that would buy a decent CD-based home audio system. But the sound coming from your PC, frankly, isn't all that great. Is there something wrong with the sound board installed in your PC, or with the CD-ROM drive? It's possible your board is faulty, but it's more likely that the problem lies with the state of the art in today's so-called multimedia solutions.

That's unfortunate, because we're beginning to see real business uses for sound-equipped PCs, including animated tutorials, voice synthesis, and voice annotation. In this issue's review of 45 PCs equipped with sound boards and CD-ROM drives (see the cover story, "Sight & Sound"), we were disappointed by what we heard in the vast majority of the systems.

What's wrong with sound boards? You name it: difficult installation, limited tech support, unlabeled jacks and connectors, cheap microphones, marginal noise suppression, and inadequate amplification.

Many boards do a lousy job filtering the power coming from your PC, so you get low-frequency noise when you turn up the volume. Others combine the preamplifier and amplifier into one unit, a compromise that kills sound quality if you have amplified speakers. And some boards attain their 3- to 5-watt output by not reproducing the highest and lowest frequencies. While the sound is worse, you no longer hear any low-frequency noise from the power supply. Talk about killing two birds with one stone!

The sound board isn't the sole culprit: Some CD-ROM drives put out impure signals. And admittedly, the interference inside a PC makes it a tough place for high fidelity.



Today's multimedia solutions will ring up the cash register. They'll probably leave your ears ringing, too.

WHAT TO BUY

If you're looking for quality sound, stick with 16-bit boards (8-bit boards are okay for games). If you want to play music, find a board that uses *wavetable lookup*, meaning digitized recordings of actual instruments rather than FM synthesis. Also, an on-board digital signal processor takes a load off the CPU.

My favorite midpriced board is the Media Vision Pro Audio 16 ($249). If you have amplified speakers, the Creative Labs Sound Blaster 16 ASP ($349) works well too. If you want flawless sound quality, there's only one choice today: the Turtle Beach MultiSound ($599). Don't skimp on speakers. Decent speakers for voice and low-volume music are about $100, and the best (Altec-Lansing, AR, Bose) run $200 to $300.

If you now have a sound board that doesn't sound so good, before you toss it, try grounding the board. Specifically, run a wire from one of the board's ground points (under a screw head) to the grounding screw on an electrical outlet. Can't hurt. And it could improve sound quality.

If you do buy a do-it-yourself upgrade, good luck. As my colleague Jim Seymour notes, sound boards and multimedia upgrade kits (sound board, CD-drive) should carry the warning, "Do Not Install Until Monday." Installation can require tech support not available on weekends.

Sound is becoming so important, and prices are coming down so much, that we'll soon see sound features built into PCs. That will cure the installation hassle and maybe some of the interference problems sound boards experience today. In the meantime, if you're thinking about putting a sound board and a CD-ROM drive in your PC, it may be time to consider a whole new system. Buy it with the sound board and drive already installed. Life is too short for hassles. □

Illustration by Rob Colvin

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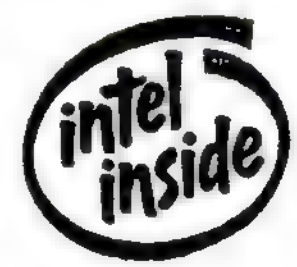

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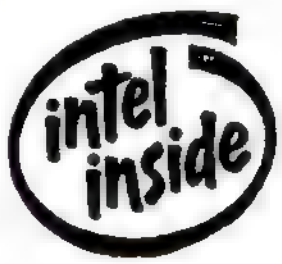

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MULTIMEDIA

Sight &

Adding a CD-ROM and sound card to a PC's video capabilities opens up a world of multimedia on the desktop. Here, 45 PCs with audio shoot it out to see which are the best all around.

by Christopher Barr

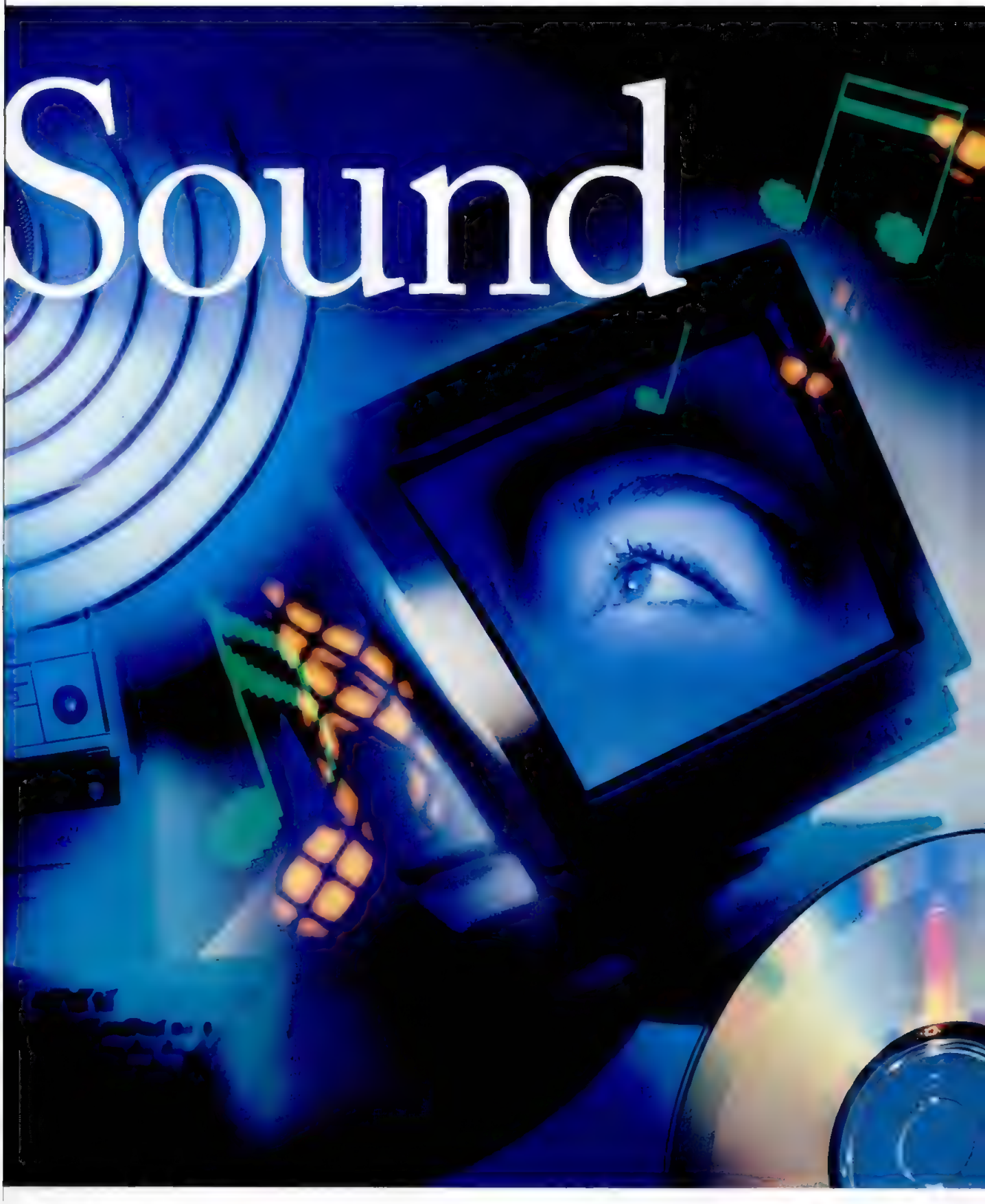
The siren's song of sound and video on a desktop PC has a powerful allure. In our everyday use of computers, who wouldn't want to harness the powerful communications media we take for granted—music, voice, and moving pictures—to fashion new ways of creating, presenting, and viewing data? This marriage of audio and video, which will result in nothing less than a new way of working, is what multimedia is all about.

In a perfect world, outfitting a PC for multimedia should be no more difficult than finding a good all-around PC and installing a CD-ROM drive, a sound board, speakers, and specialized software. Certainly, a good multimedia system starts with a good PC. But because adding sound to the picture requires the simultaneous manipulation of a broad range of data types, a system with massive bandwidth is needed to process and move sound and visual images.

A picture may be worth a thousand words, but how many megabytes of disk space is a video clip worth? Even in compressed form, 1 minute of digitized real-time video requires 1,800 full-color frames, which can easily take up 15MB of disk space; stereo sound adds another 10MB. Playing them together can cause the PC equivalent of hardened arteries.

As multimedia goes mainstream and gets down to business, systems that play sound as well as video require more than optimized components. Integra-

Sound



Photograph by Geoff Spear

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tion is key, because multimedia performance is dependent on all the components working in harmony. As a result, choosing the wrong sound board or CD-ROM drive can degrade the sound you hear. Because of all the electromagnetic interference in a PC, one that is not carefully wired or correctly grounded can sound like a cheap radio. And it won't do you much good if you have a top-of-the-line sound board running $10 speakers, or—conversely—high-end stereo speakers on a monotone sound board.

Because of its 680MB data-storage capacity, CD-ROM is becoming de rigueur for PCs. CD-ROM is a good medium for distributing large databases or applications, such as Version 2.1 of IBM's OS/2, which resides on 21 3.5-inch floppy disks or on a single CD-ROM. Also, CD-ROM is becoming the standard for image files such as Kodak Photo CD. A survey of *PC Magazine* readers showed that half want a CD-ROM on their next system.

On the downside, CD-ROM, which stands for *compact disk–read-only memory,* is a one-way data stream coming out of the drive; any applications you create will have to be stored on a hard disk or some other medium. Also, throughput and the speed at which CD-ROMs are read are still too slow for many applications to run smoothly.

MAINSTREAM MULTIMEDIA

For the past two years, multimedia has been touted as the next big thing. Multimedia has failed to cross the threshold into the mainstream because of the anemia of most multimedia PCs. That is changing quickly. Desktop video requires a powerful processor to digitize a video signal and then play it back at an acceptable speed. Local-bus video, a technology just hitting its stride, provides the throughput to pump vast amounts of video data to your display, which means you can have it all: high resolution, color-filled screens, and full-motion video.

As for audio, sound boards used to be the domain of game systems, but Microsoft Corp. opened the PC to business computing with sound when it included sound support in Windows, Version 3.1. Using Object Linking and Embedding (OLE), you can record messages to be either played back in spreadsheets or attached to e-mail messages. Microsoft Windows Sound System and other products have the ability to read numbers from a spreadsheet or verbally proofread a word processing file. Today's sound boards will play the audio portion of games, as well as MIDI (Musical Instrument Digital Interface) files that can accompany business presentations. Most will play in audio CD–quality stereo.

In 1991, seeing an opportunity to put all the pieces together and define an emerging market, a consortium of vendors set a minimum platform for multimedia PCs that became known as the MPC (Multimedia PC) standard. Antediluvian by today's standards, MPC meant at least a 386SX processor, an 8-bit sound board, a 150-kilobyte-per-second CD-ROM drive, and VGA video. The few software products that existed—mainly encyclopedias and games—ran like molasses on such underpowered systems. The MPC consortium regrouped and issued a new, more relevant—though far from perfect—standard in spring 1993. The MPC-II standard calls for a 486-or-better processor, 16-bit audio, and a 300KBps CD-ROM drive. VGA colors are increased to 65,536, and the standard suggests 8MB of RAM.

REVIEW CRITERIA

For this roundup, we tested midrange systems that came equipped with CD-ROM drives and sound boards and were priced at or below $2,750. We shadowed the MPC-II criteria by asking for processors that were 486SX/25 or better, 8MB of RAM, a monitor, a keyboard, DOS and Windows, a mouse, and a CD-ROM application to try in the test unit. To determine the audio possibilities that a given PC offers, we asked each vendor to ship us a set of speakers, though their price was not included in our tabulation. Al-

Our Contributors: CHRISTOPHER BARR is a senior editor of *PC Magazine.* OLIVER RIST is a staff writer for *PC Magazine,* and ANUSH YEGYAZARIAN is a senior editorial researcher. BRUCE BROWN is a contributing editor to *PC Magazine,* and STEPHEN W. PLAIN is a frequent contributor. BRIAN NADEL was the associate editor in charge of this story, and TAMI D. PETERSON was the project leader.

though you can find multimedia systems cheaper than $2,750, less expensive systems may not handle multimedia with ease.

Altogether, we received 45 systems that spanned the processor range from a 486SX/25 to a 486DX2-66. The most popular chip was the 486DX/33, found in 15 systems. Two systems came with IBM-manufactured motherboards: One had an IBM 486SLC2-50, the other an IBM 486SCL2-66. Two more systems used the Cyrix CX486S-40 chip. Price kept Pentium-based systems out of this roundup, although this processor's 64-bit operation and dual pipelines certainly give it the muscle multimedia systems need. Prices, current as of mid-August, ranged from $1,779 right up to the $2,750 ceiling.

While the 45 multimedia PCs reviewed represent a good cross section, the Tandy Sensation! is notably absent.

RECENT REVIEWS

- **Family Values**
  September 28, 1993 ..... Page 116
- **Power Without the Pounds**
  August, 1993 ..... Page 125
- **Pentium PCs: The New Standard**
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The Sensation! defined early multimedia computing and is being redesigned to meet MPC-II requirements.

OVERALL DESIGN

A multimedia system that won't disappoint starts with a good PC. We took a two-pronged approach to reviewing, separately evaluating each system's general capabilities and sound quality. Several systems excelled in certain areas.

- MS Engineering's MSE486DX2-66V impressed us, posting many benchmark test results at or near the top, but it was disappointing on our DOS video and disk tests.
- Micron Computer's Micron 466VL Magnum MPC led with its combined processor, memory, and graphics Windows scores, but disk scores lagged.
- NETiS Technology's NETiS N4D266VL placed first in processor and DOSmark testing, but it failed to deliver in Windows graphics.
- The Gateway 2000 4DX2-66V placed first and second, respectively, on our processor and memory tests, but it fell back on our other tests.
- International Instrumentation's Blue Max Multimedia Monolith, powered by a 486DX/33 processor, cut a steady course through our tests, leading on our

HIGHLIGHTS

Multimedia PCs

A GOOD MULTIMEDIA PC starts with a solid all-around system with additional sound-based components that complement one another. Matching the right CD-ROM, sound card, and speakers is crucial to getting good audio results.

SOUND AND MOTION VIDEO is not as easy as it looks. Audio/visual presentation puts enormous demands on a PC. Just 1 minute of full-motion video with stereo sound can take up 25MB and slow the system to a crawl.

CD-ROM DRIVES are de rigueur for multimedia because of the disks' 680MB capacity. Alas, the drives are still slow, have low data throughput, and don't allow writing to disk.

SOUND IS NO BETTER than your system's weakest link. Unfortunately, most systems reviewd disappointed us in terms of audio quality. Strive for high-quality products that work well together.

TREAT THE MPC STANDARD as the minimum you'll need for multimedia. Shoot higher when you are considering a multimedia PC. Aim for a 486DX/33- or DX2/66-based computer with a 16-bit stereo sound card, 15-inch SVGA monitor, dual-speed CD-ROM drive, and the largest hard disk you can afford.

SEVERAL SYSTEMS were good overall PCs, such as the MSE486DX2-66V, Micron 466VL Magnum MPC, NETiS N4D266VL, and Gateway 2000 4DX2-66V. Only the Blue Max Multimedia Monolith performed well as a general PC and had acceptable sound quality results.

ALTERNATIVE MULTIMEDIA platforms are currently available. The $2,489 Macintosh Centris 660AV, for example, is a less speedy choice. But it may be able to handle some aspects of multimedia better than the PC. At the other extreme stands the Silicon Graphics Indy system, which integrates a MIPS R4000 RISC processor, a 15-inch monitor, 16MB of RAM, sound, high-end video, and a color video camera for $5,000, not including mass storage.

SPEAKERS ARE THE VOICE of the multimedia system, and cutting corners doesn't pay. The best we've found are the Acoustic Research 570 wedge and the Altec Lansings ACS 300, though they can cost more than $200 per set. Steer clear of systems that incorporate speakers into the system unit box, because this limits the flexibility of placing the speakers at the right distance from and angle to the listener.

SOUND QUALITY is dependent on the CD-ROM/sound card combination. The audio top end was dominated by the Media Vision Pro AudioSpectrum 16 and Creative Labs Sound Blaster boards. The best overall audio quality was in systems from ACR, Ares, Axik, Compudyne, Comtrade, EPS, Epson, International Instrumentation, National MicroComputers, and Unitek.

DOUBLE IS BETTER THAN SINGLE for CD-ROM drives. Double-speed drives will give you high data throughput and quicker access speeds. The next step will be triple- and quadruple-speed CDs.

DOS and Windows disk tests and lagging in none.

Our ideal configuration for a multimedia PC runs a tad higher than these configurations. We prefer either a 486DX/33 or a 486DX2/66 processor, 8MB of RAM, 1,024-by-768 resolution with 256 colors on a VL-Bus, and a hard disk capacity of 500MB.

But there are several non-Intel-based multimedia systems. Apple's Macintosh was the first to put sound on the motherboard, and it integrates QuickTime, its desktop video standard, into the operating system. At $2,799, the Centris 660AV is the closest to our price ceiling, but it is a mixed bag. The Centris, which is based on a 25-MHz 68040 processor and includes a 230MB hard disk, would most likely have performed below most of the systems reviewed. On the other hand, it uses a digital-sound processor, which is included on only the best sound boards.

By contrast, Silicon Graphics' Indy desktop system (just under $5,000), uses a MIPS R4000 RISC processor and includes a 15-inch monitor, 16MB of RAM, sound, high-end video, and a color video camera. But the CD-ROM drive is $1,200 extra, and a 340MB hard disk costs another $1,500. The Indy does come with software to capture full-screen video to disk, as well as perform some video editing. Since it runs Unix, you can't use your favorite PC applications with it.

FIRST USES

At its best, multimedia will open a wealth of new applications for business, education, and home applications. The first systems will be for training, demonstrations, and spicing up static presentations. They might add multimedia ingredients such as an animated movie of how an engine is taken apart or what happens if you add the wrong chemical to another.

The tenets used in training can be applied to education as well. Microsoft's Multimedia Beethoven: The Ninth Symphony takes viewers through the piece, letting them move between a note-by-note analysis and the score itself. And Software Toolworks' 20th Century Video Almanac offers some of the most interesting images of the century, from clips of the 1916 World Series to Woodstock.

PC MAGAZINE ▶ EDITORS' CHOICE

- **International Instrumentation Blue Max Multimedia Monolith**

The demands of adding rudimentary sound capability to a mid-range personal computer can stretch a PC to the breaking point. As if combining accurate and vivid audio reproduction via a CD-ROM drive and sound card in a good all-around PC were not hard enough, we set a price ceiling of $2,750. The bottom line is that most PCs in this review did not fare well at combining sight with sound.

Many of the computers we examined impressed us as having all the necessary features for solid overall performance, being capable of conquering both the DOS and Windows camps. Among them were the Comtrade Multimedia (VL-Bus) 66, the Gateway 2000 4DX2-66V, the Blue Max Multimedia Monolith, from International Instrumentation, the Micron 466VL Magnum MPC, the MSE486DX2-66V, from MS Engineering, and the NETiS N4D266VL. At the other extreme, we saw many systems that, while providing audio of the quality required to accurately reproduce voices, music, and sound effects, still fell short of the mark, either because of generally poor PC performance or because of the lack of one key feature.

SING THE BLUES

International Instrumentation's Blue Max Multimedia Monolith was the only PC able to bring the buyer the best of both worlds by merging powerful computing with the ability to replay quality sound. It is a multimedia system that does not compromise in terms of sound for general operation or vice versa.

Priced at $2,699, the Blue Max Multimedia Monolith starts with an excellent general PC with such features as 256K of external cache, a VESA VL-B local bus, a 250-watt power supply, and a mini-tower case. The presence of five 16-bit ISA and three VESA local bus slots, as well as five drive bays, clearly make International Instrumentation's Blue Max Multimedia Monolith a system that can grow with you as your style of computing becomes more complex.

While most of the high-flying PCs in this roundup were powered by Intel 486 DX2/66 processors, the International Instrumentation system did quite ably with a less powerful DX/33 CPU. It still managed to score at the head of the pack on six of our benchmark tests, and it never fell to the rear on any. Indicative of its even-handed performance, the Blue Max system ranked at or near the top on both the DOSmark and Windows Applications scores and, in the effort, bested five DX2/66-based PCs. The key is the system's local bus for both graphics and disk control that effectively removes data bottlenecks suffered by many other PCs in this review.

While many systems disappointed with their poor matching of sound card and CD-ROM, International Instrumentation (along with ACR Systems) excelled by mating the Creative Labs Sound Blaster 16 ASP card with Toshiba's XM-3401B dual-speed CD-ROM drive (an expensive upgrade on many of the systems we reviewed). The drive showed both the fastest access time and the highest data throughput of all the CD-ROM units tested in this roundup. Add to that the Genoa Windows accelerated video subsystem and you have competency in both audio and visual realms.

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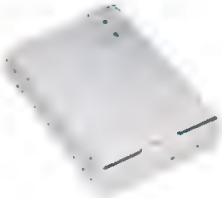

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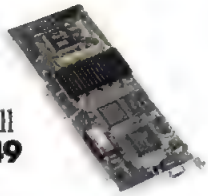

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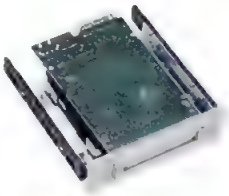

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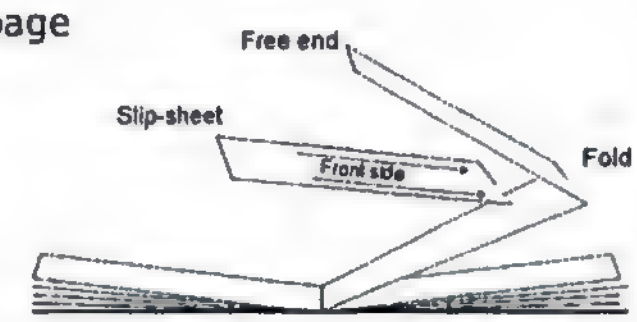

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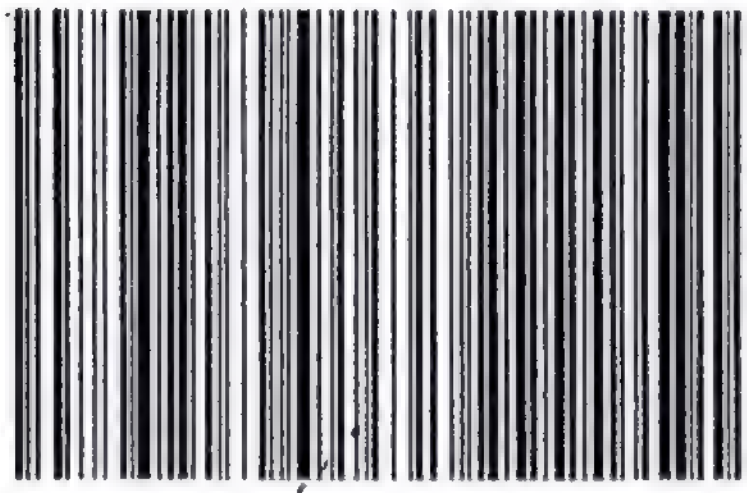

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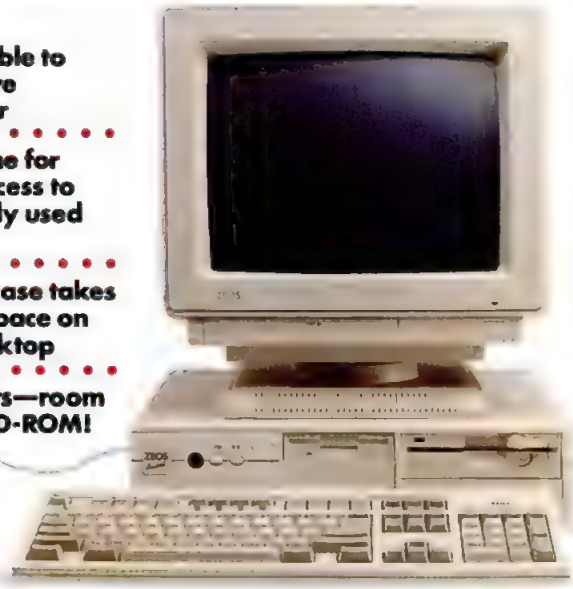

"At such bargain prices, home offices can snap up these space-saving PCs without breaking the bank."

–PC World, August 1993

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CIRCLE 036 ON READER SERVICE CARD

Suitability to Task: Multimedia PCs

DOS applications reflects a PC's ability to run DOS software quickly. Top systems have at least a 200MB hard disk and a DOSmark score in the top 25 percent of the roundup

The **Windows applications** rating indicates how well a system operates Windows software. Factors include the DOSmark and Graphics and Disk Winmark scores, as well as the maximum motherboard RAM, hard disk options, the maximum noninterlaced video resolution, the monitor size, and the presence of a mouse port.

Expandability refers to a system's potential for growth. Considerations include ease of processor and external cache upgrades, system BIOS, hard disk options, maximum motherboard RAM, available drive bays and bus slots, and the presence of 16550 UART support.

Multimedia components we tested included the CD-ROM drive and sound board. The overall sound quality rating incorporates results from Total Harmonic Distortion (THD), Signal-to-Noise Ratio, and Frequency Response tests, with slightly more emphasis being placed on THD. Also considered was whether the CD-ROM drive could output a full watt of power to the sound board. Systems are rated as *good, fair,* or *poor,* none were rated excellent

▶ Product Name	
SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	FAIR
Multimedia	POOR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	BELOW AVERAGE

Service and Reliability

In our 1993 Service and Reliability Survey, we sent questionnaires to 17,000 subscribers; about half replied. Vendors for whom we received at least 50 responses are rated *above average, average,* or *below average* in three areas:

Reliability scores indicate to what degree PC owners felt their systems met their overall expectations for consistent operation

Repair service scores are culled from users who contacted the vendors to have their PCs repaired

Technical support scores measure how well vendors' telephone support met respondents' expectations

But we expect business to be where multimedia succeeds first. CD-based applications are already using multimedia to demonstrate products' capabilities. One example is Microsoft Works, which has an animated dog that jumps from screen to screen. Lotus 1-2-3 for Windows, Release 2.0, comes with Multimedia SmartHelp, which takes this concept a step farther with a cartoon of a tuxedoed man who shows you around the program's help section as a voice describes what to do. This is a great tool for beginners, but it can be tedious for advanced users. At the other extreme, WordPerfect Presentations and other presentation programs let the user integrate sound and crude animation into a presentation.

Beyond that, videoconferencing beckons, which beyond requiring a microphone and a camera will need a wide data highway to handle images and voice. At present, this area is limited to the use of expensive and at times hard-to-get ISDN (Integrated Services Digital Network) lines. Compressing video and sound may soon allow the use of phone lines, but today the result is herky-jerky video.

THE AGE OF THE LOCAL BUS

The proper display of video requires a robust expansion bus. It is important to note that this roundup marks a sort of coming of age for the local bus, with all the tested systems using some type of local-bus video to speed graphic presentation. Local-bus video is important when running video on a PC. Video may appear smooth at 30 frames per second (fps) on a local-bus PC but will drop frames and run at 10 to 15 fps on an ISA-bus PC. In this group, 41 PCs used the VL-Bus for video; the others used a proprietary local-bus system. We saw no MCA-bus systems and only 4 EISA-bus PCs. The rest used an ISA bus.

Bringing in sound proved more difficult. While all the systems came with sound boards—mostly from name-brand suppliers—most disappointed us on overall audio quality. The Media Vision Pro AudioSpectrum 16 audio card (a former Editors' Choice; April 27, 1993) was the most popular choice, turning up in 11 systems.

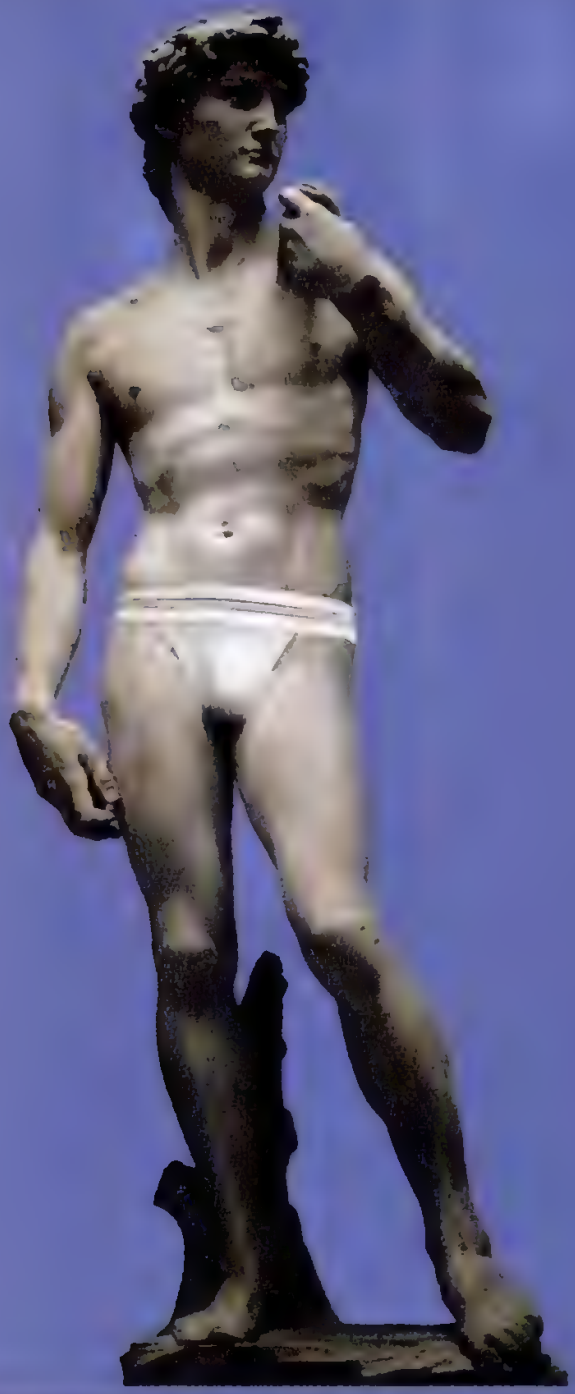
The newer, higher-end Media Vision Pro AudioStudio 16 showed up in five others. The Creative Labs Sound Blaster 16 ASP came in seven PCs; the Sound Blaster 16 was in four others. The original Sound Blaster Pro unfortunately came installed in four machines. Thunder Media's Thunder Audio Spectrum 16 was in six PCs, and the Aztech Sound Galaxy NX Pro 16 was in five. A variety of other sound cards (including the Microsoft Windows Sound System) were in the other three PCs.

All sound boards are not created equal. For instance, the Media Vision Pro AudioStudio 16, which lists for $349, has digital signal processing that can convert text to synthesized speech. This is not found in the older Media Vision Pro AudioSpectrum 16, which sells for $299.

While it's important to get the features you want in a sound board, tests showed that even a good sound card will sound bad in a poorly designed system. What we didn't get was any of the truly high-end sound cards, such as the Turtle Beach MultiSound, which can record and play back actual sounds, not synthesized versions of them. While boards of this level cost in the neighborhood of $600, the sound they produce is worth the extra money. The irony is that several of the systems tested could have still made the price cut with a high-end sound card.

Speakers are another area where cutting corners doesn't pay. The price range for speakers in this roundup was $10 to about $400, and most had the fidelity of a cheap radio. An impartial jury listened to the same selection of classical music on all speakers through a reference PC and judged the best to be Acoustic Research's $399 570 wedge speakers and Altec Lansing $400 ACS 300 speakers. The latter set uses a separate box to improve bass response. We suggest you treat this portion of your multimedia PC as if it were a stereo with a PC attached and seek high fidelity.

Listen to many speakers, choose carefully, and be wary of those systems



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LOGITECH

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What the Numbers Mean

A quality multimedia PC is much more than a capable personal computer that has a CD-ROM drive, sound card, and speakers attached. The best systems in this roundup use carefully matched components for optimal audiovisual performance.

PROCESSOR AND MEMORY

Of the 45 multimedia systems in this review, the 14 486DX2/66 systems—each with 256K of external cache—ranked first through fourteenth in processor performance, with scores ranging from the NETiS unit's high of 17,338 operations per second to the Unitek unit's low of 13,625.

The two 486DX2/50 systems, by FutureTech Systems and Dyna Micro (13,119 and 12,591 operations per second, respectively), took fifteenth and sixteenth place. Behind those two was Eltech's system, based on IBM's 486SLC2/66 CPU, which performed more on a par with an Intel DX2/50 processor. Unlike Intel's clock-doubled 66-MHz CPU, which is a 32-bit design throughout, IBM's SLC2 design uses a 32-bit interior and a 16-bit exterior.

The midrange CPU of the group was the 486DX/33, followed by the Cyrix 486/40 processor, which appeared in the Tangent Computer and Diamond Technologies systems, and the IBM 486SLC2/50, on board the C^2 Saber Sound. The Compaq, Comp & Soft, and IBM PCs, with 486SX/25 processors, placed at the bottom of the heap.

The obvious trend toward high performance in system memory points to the Micronics x-30–series motherboard, which produced the top three memory performers—the Gateway 4DX2-66V, the Micron 466VL Magnum MPC, and MS Engineering's MSE486DX2-66V. With scores around 9,700 kilobytes per second (KBps), these three 66-MHz systems achieved processor scores that were 88 percent better than the average.

DOS VIDEO

DOS video results continue to resemble an upside-down Graphics Winmark performance chart. The top ten systems in Graphics Winmark scores, all carrying Weitek's Power 9000 chip on either a Diamond Viper VLB card or an Orchid P9000/VLB, sat at the bottom in DOS video performance. Their scores ranged from a high of 3.3 million operations per second for the EPS Multimedia 486-DX2/66 VLB to a low of 2.6 million for the ATronics ATI-486 Multi Media. The only system to join the Weitek-based units in the performance basement is the Epson Endeavor WG. This unit, with a Chips & Technologies F64200 graphics chip, carries the dubious distinction of placing thirty-seventh in DOS video and thirty-eighth in Windows video.

The Dell 433s/L Family Station offers exceptional DOS video with slight Windows compromise. Thanks to the Tseng Laboratories ET4000/W32 video chip set integrated on Dell's proprietary local-bus motherboard, the system took first place in VGA performance, with a score of 13.2 million operations per second, while still garnering a respectable Graphics Winmark score of 13.7 megapixels per second. Using the same Tseng chip on a VL-Bus card, the Comtrade took a fourth-place position in DOS video, with a score of 12.1 million operations per second, and achieved a Graphics Winmark score of 16.8 megapixels per second.

DOS DISK AND DOSMARK

Of all the tested systems, 39 came with a local-bus hard disk adapter, in 19 cases equipped with hardware cache. The most impressive hard disk performance came from the 486DX/33-based International Instrumentation Blue Max Multimedia Monolith, which performed almost three times as fast as the average system. Boosting the performance of its 250MB Conner CP30254 hard disk with 64K of built-in cache was a Promise Technology DC-4030VL adapter with 4MB of on-board cache. The same Promise card, with varying amounts of cache, was paired with a variety of hard disks in the seven systems that scored best in disk tests.

In the same league with the Promise card was Bus Logic's BT-445S adapter. MS Engineering's system, with its Quantum ProDrive 240S SCSI drive and the Bus Logic card, was in eighth place on our disk tests. A 2MB version of TekRAM's DC-680 caching adapter came with the Vectron Business Multimedia and the Duracom Multimedia DeskSaver 486/33SX, in tenth and eleventh positions, respectively.

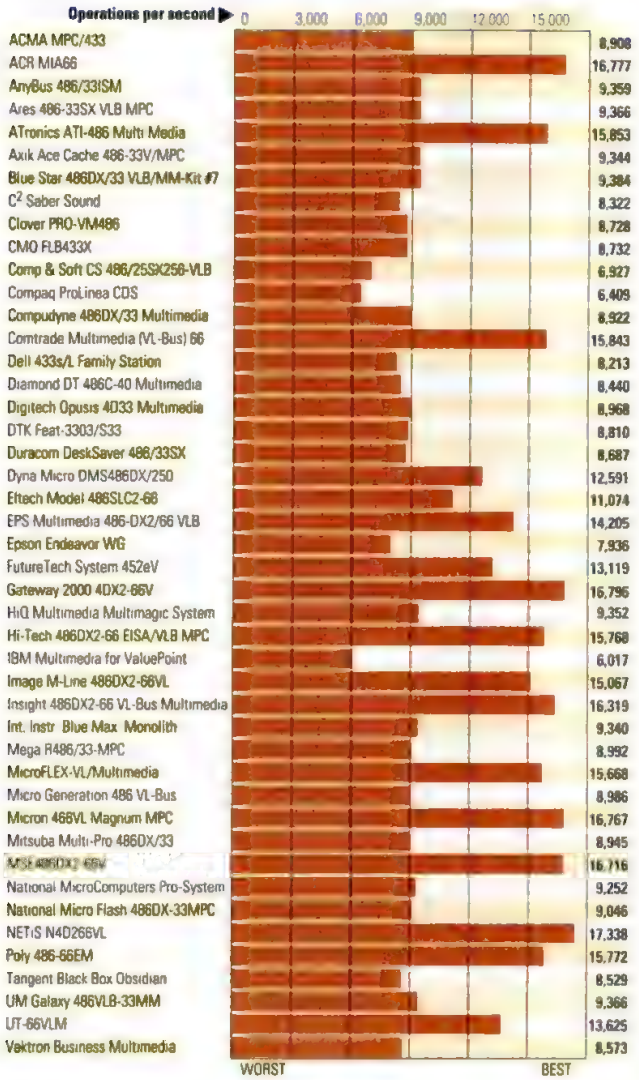
Since the DOSmark formula takes both processor and hard disk performance into account, the winners in this category included those systems that combine top-performing drives with high-end processors. The NETiS unit placed first on our processor tests and second in hard disk performance, making for a first-place DOSmark score—tied with the MSE, which placed fifth on processor and eighth on disk tests.

GRAPHICS WINMARK

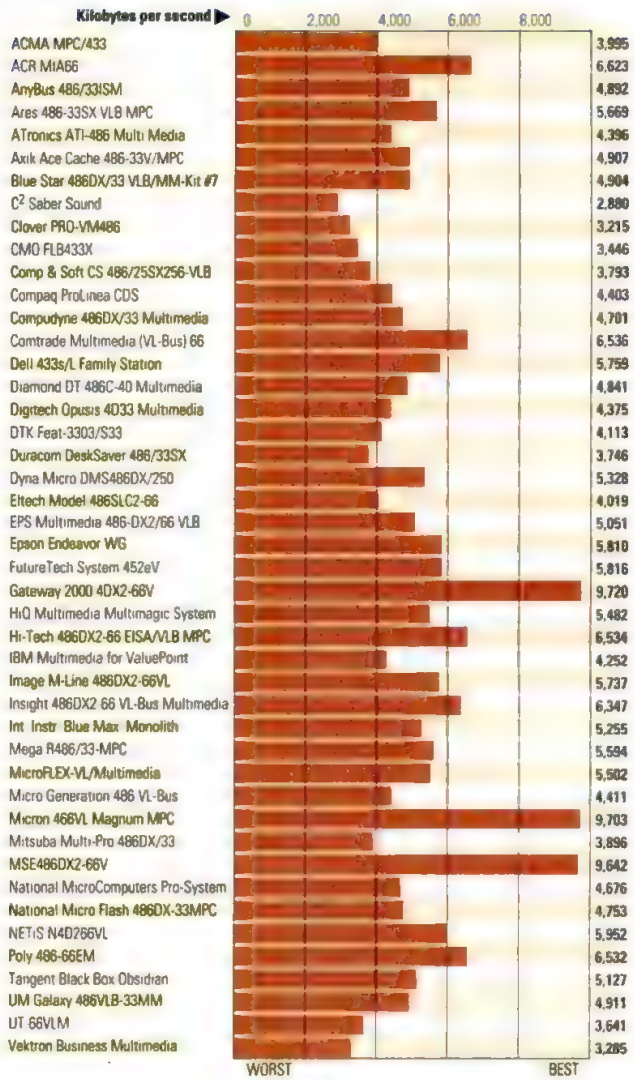
The top ten Graphics Winmark scores ranged from the Compudyne's 22.9 megapixels per second to the Micron's 54.1. While CPU differences among these two machines and several others in the top ten partially account for the wide performance spread, having the most recent drivers helped performance.

Outside of the Windows power elite, the Gateway 2000 4DX2-66V carried the ATI Mach 32 graphics accelerator on an ATI Graphics Ultra Pro card. The result—10.9 megapixels per second—was in line with the five other

PROCESSOR



MEMORY



systems containing the same video subsystem. Of these, the MicroFLEX-VL/Multimedia achieved the highest score—15.1 megapixels per second—while the Micro Generation unit scored the lowest—10.4 megapixels per second.

S3's 86C928 video chip shipped in the Ares 486-33SX VLB MPC on a Diamond Stealth Pro VLB. But with a score of 14.8 megapixels per second, it didn't perform as well as the 86C805 on the Actix Graphics Engine 32VL inside National MicroComputers' NMC Universal Pro-System, which scored 15.9 megapixels per second. Since both systems are DX/33s, and the Ares did slightly better than the Pro-System on both CPU and memory tests, drivers and processor cache may account for the difference.

DISK WINMARK AND WINDOWS APPLICATIONS

Disk Winmark scores usually follow hard disk performance, while scores on the Windows Applications test suite tend to correlate with processor, memory, and Graphics Winmark scores. Because of its outstanding hard disk performance, largely due to its 4MB Promise caching controller, the Blue Max Multimedia Monolith took top Disk Winmark honors. At 63.84 KBps, the Blue Max Multimedia outpaced the second-place AnyBus 486/33ISM with a score of 54.53 KBps. Also with a 4MB Promise card, the DTK Feat-3303/S33 placed fifth on the Disk Winmark test suite.

SOUND CARD/CD-ROM

Sound cards installed in the 45 multimedia PCs came from seven different vendors: 31 from Creative Labs or Media Vision and 11 from Aztech Labs or Thunder Media, while three systems used Diamond Computer Systems, Microsoft, and LaserWave cards.

Systems with Creative Labs' three Sound Blaster designs produced roughly two gradations of sound quality. The orig-

Two w
make a

If patience is a virtue, it would be tough to find anyone more virtuous than a 386 user.

Of course, you're not waiting to be canonized. You just want to get your spreadsheet crunched, printed and e-mailed before your boss's boss calls you looking for it.

Now if you had a 486, you wouldn't have this problem. But all that wishful thinking goes out the window when you consider the double-knots on your company's purse strings.

Performance Benchmarks

(figures indicate relative performance)	Intel i386	Cyrix 486 Upgrade
MS Excel 3.0	1.0x	2.1x
MS Word 2.0	1.0x	2.8x
Micrografx Designer 3.1	1.0x	2.6x

Benchmark tests run on IBM PS/2 Model 70/20MHz

The new Cyrix 386-to-486 Upgrade Microprocessor delivers application performance that's twice as fast. And that's twice as smart.

Fortunately, there's a smarter alternative to the downward migration path pictured above. It's called the 386-to-486 Upgrade Microprocessor.™ And it's only available from Cyrix,® the smarter microprocessor company.

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Our upgrade chip acts just like a 486, and with good reason. It has Clock Doubling, a 1K on-chip cache

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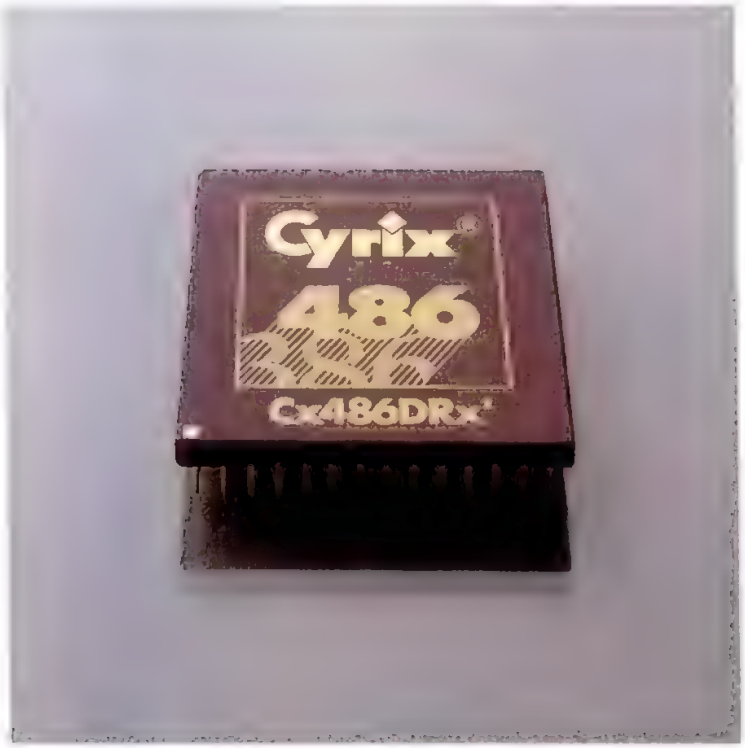
ays to 386 fly.



and enhanced Cx486 technology. Which means it delivers *twice* the application performance, and 100 percent compatibility with all your software. Like DOS, Windows and OS/2. Even Windows NT. It's also certified software compatible in Novell, Banyan and Lan Manager nodes.

MICROSOFT WINDOWS COMPATIBLE

yes it runs with NetWare

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Every Cyrix upgrade chip comes with the reassurance of a limited lifetime warranty, toll-free telephone support, and a money-back guarantee.

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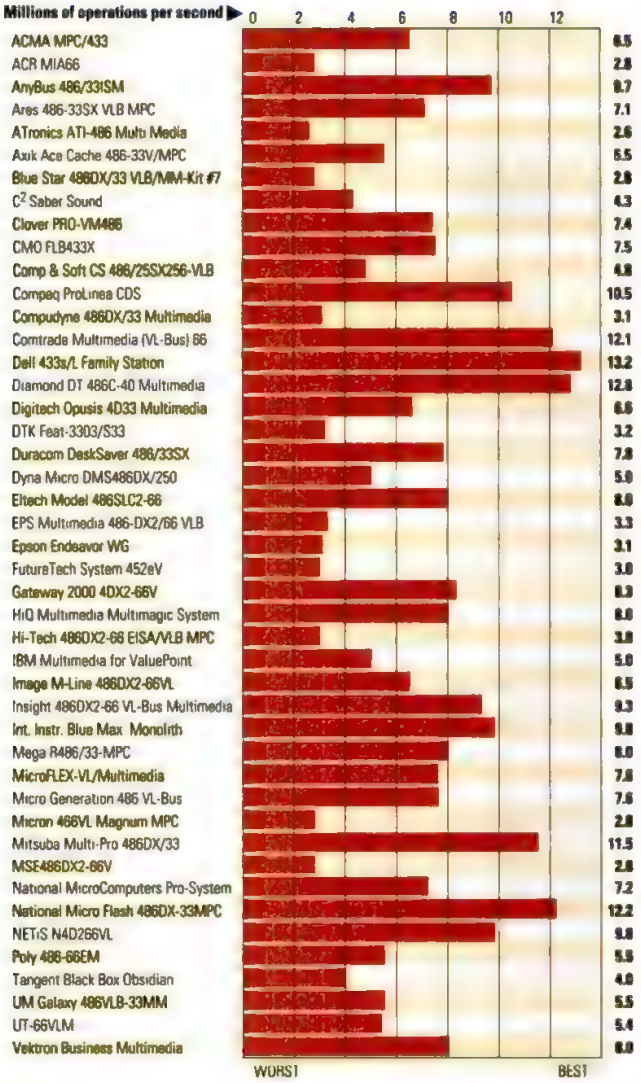
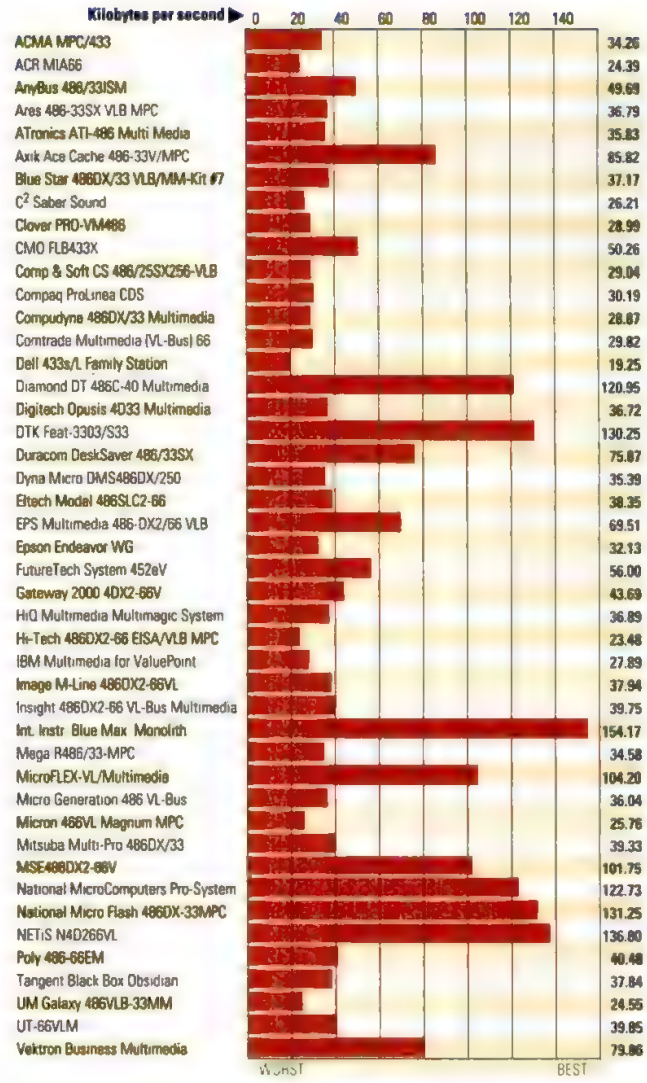
VIDEO



DISK



inal Sound Blaster Pro, in systems from ATronics, Diamond Technologies, DTK, and NETiS, produced an unacceptable Total Harmonic Distortion (THD) between 10 and 32 percent. Creative Labs' newer Sound Blaster 16 and 16 ASP models, however, performed much better. THD was below 0.6 percent in most systems. Signal-to-Noise ratios (S/N ratios) were good for the entire Creative Labs group. But frequency response results were poor for the Pro set, with severe high-frequency roll-off around 7 kHz. By contrast, response for the systems with 16s and 16 ASPs was good—up to 20 kHz in most cases.

Similar performance was observed in the 16 systems using Media Vision drives. The older Pro Audio Spectrum 16 for the most part produced THDs below 0.2 percent. The newer Pro Audio Studio 16 boards, however, showed severe distortion, with THDs between 18 and 27 percent.

We found that the combination of CD-ROM and sound card was what really mattered. A notable combination was the Media Vision Pro AudioSpectrum 16, releases 0040 and 0044, and the Texel CD-ROM model DM-3024. In the four systems carrying these paired peripherals—from Clover Computer Systems, FutureTech Systems, Insight, and MS Engineering—distortion was as high as in the four systems with the newer Pro Audio Studio 16—from Duracom Computer Systems, HiQ Systems, Image Microsystems, and Tangent Computer. By contrast, eight other systems performed well with four different releases of the AudioSpectrum, paired with six different CD-ROM drives, one including a Texel DM-3024.

Two other cards, the Sound Blaster Pro and 16 ASP, paired with Texel drives in the DTK Computers system and the Hi-Tech USA unit, ranked unacceptable in sound quality. While Sound Blaster Pro achieved such distinction no matter what its paired CD-ROM, the 16 ASP re-

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GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
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3. Slice the folded edge
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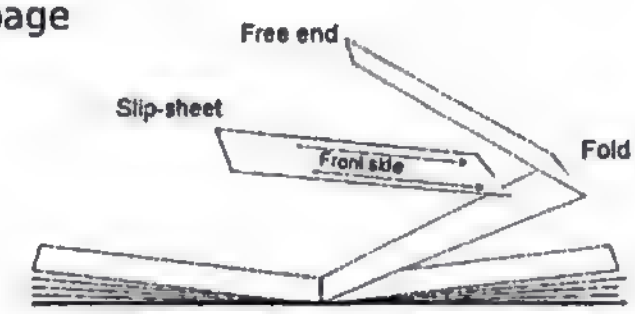

Inverted Foldout slip-sheet

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GbsSlipBack-001B

Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

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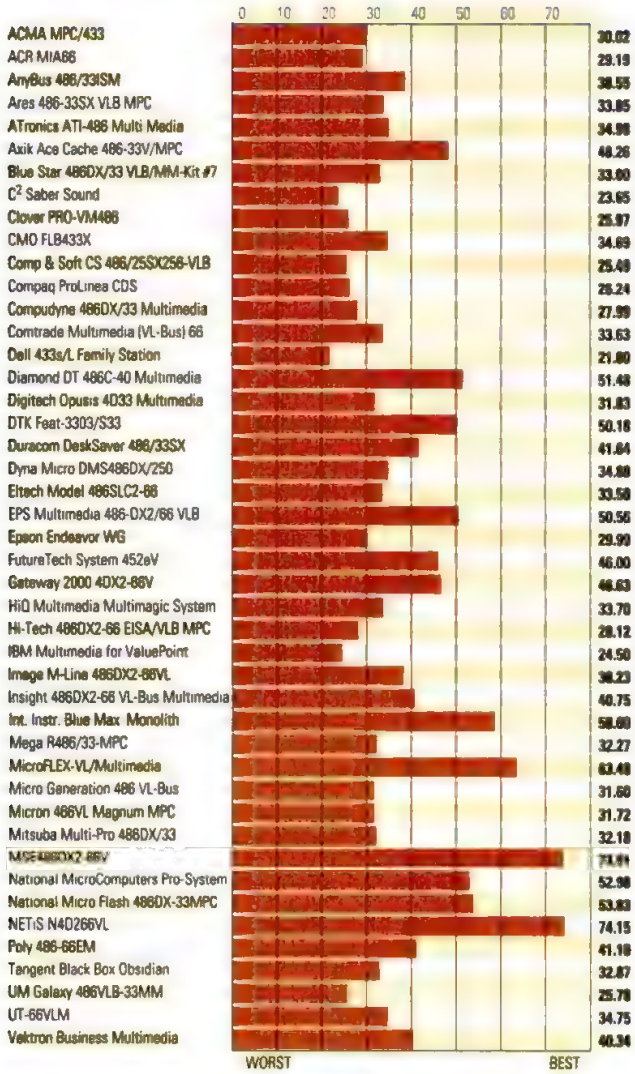
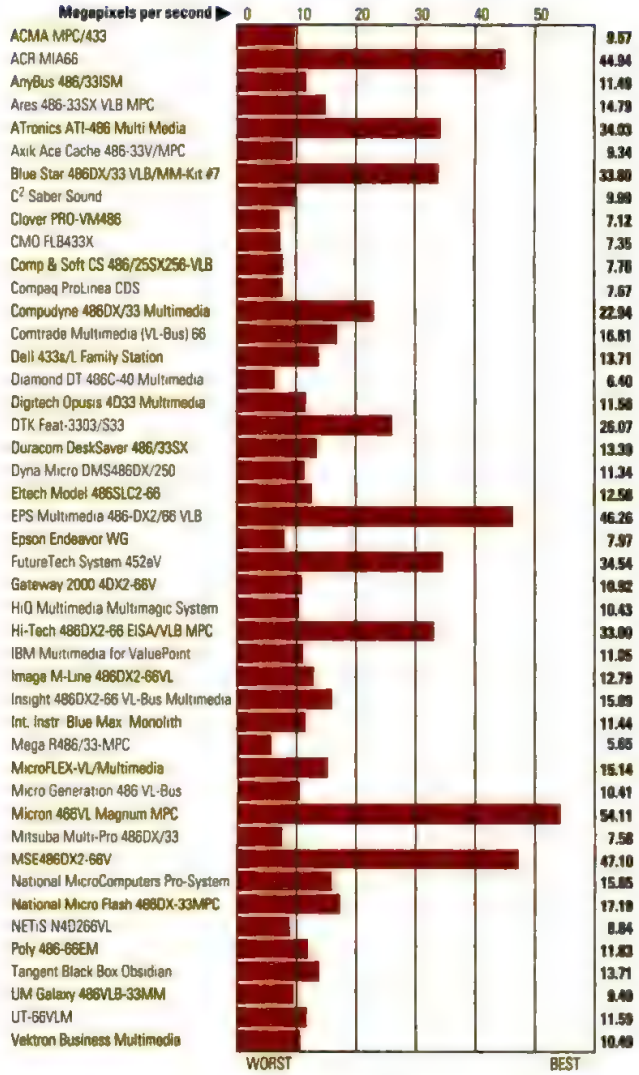
DOSMARK



GRAPHICS WINMARK



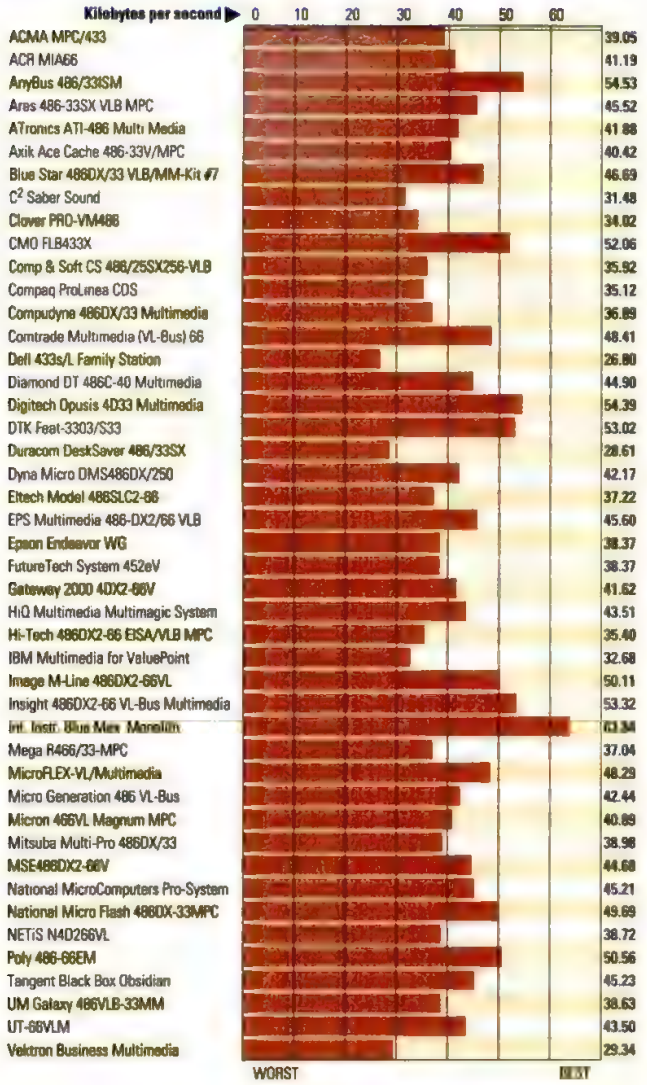
ceived good sound-quality ratings when paired with Toshiba CD-ROMs in three systems—the ACR, International Instrumentation, and National Micro Computer units. While the Sound Blaster 16 also received a good rating when paired with a Matsushita CD-523-B in Compudyne's system, all the other Matsushita drives in combination with Sound Blaster 16 and 16 ASP cards could not produce a full-watt output signal.

A similar story emerged with the Aztech Sound Galaxy NX PRO and NX PRO 16, in systems from Dyna Micro, Mega Computer Systems, and National Micro Systems. Each system earned unacceptable sound-quality ratings, using either a Matsushita or Mitsumi CD-ROM, because only a half-watt output could be reached. Inside United Micro's system, which also included a Mitsumi CD-ROM, the NX PRO 16 reached a full watt. Blue Star Marketing's entry, with a Diamond Sonic Sound card, lacks a power amplifier, so it is the only unit we tested in the preamp state. Even so, its THD was unacceptably high, at 15 percent.

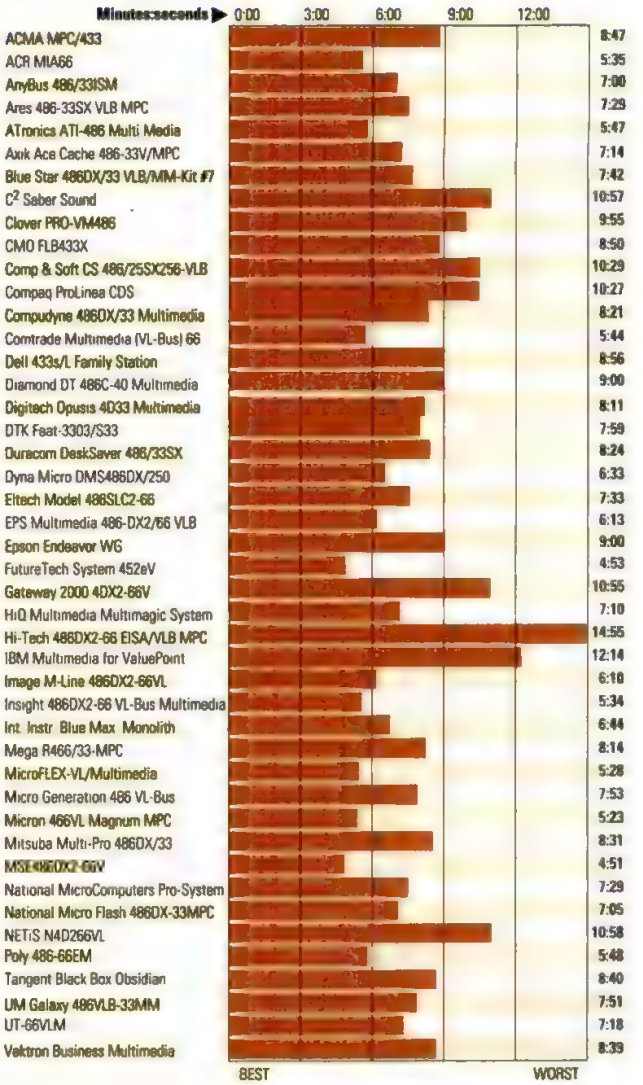
Toshiba rates the performance of its dual-speed XM-3401B CD-ROM rather conservatively, claiming the unit has a top transfer rate of 300 KBps, with a drop-down rate of 150 KBps. But each of the six systems with the Toshiba CD-ROM in this roundup exceeded 325 KBps on our tests tracking 16K sequential reads. Procom Technology resells this drive as the DR0020, which appeared in the National MicroComputers Universal Pro-System and performed on a par with its Toshiba twin.

IBM's Matsushita CR-563-B drive scored just below the Toshiba model, testing at exactly its rated speed of 300 KBps. Within two KBps was the Matsushita CR-562-B that came bundled with the Polywell Computers system. In the same speed class was the Chinon CDS-535 inside the Micron 466VL Magnum MPC. Within range of these drives were

DISK WINMARK



WINDOWS APPLICATIONS



the seven Texel DM-3024s represented. Just behind were the CD-ROM drives by NEC, which appeared in five of the systems. The remaining 23 systems each bundled a CD-ROM drive rated at 150 KBps or a dual-speed drive set for its drop-down rate.

How We Tested

We used PC Magazine Labs' Hardware Benchmark Tests, Release 7.01, to predict processor, memory, video, and disk performance using DOS applications. Each of the four scores we report is the weighted harmonic mean of the results from several tests. We also used our Windows Benchmark Tests (Winbench), Release 3.11, to obtain the Graphics Winmark and Disk Winmark scores, and the Windows Applications tests to simulate a multitasking environment.

The **processor** score is a measure of the CPU's performance and its interaction with cache and main memory. The score is derived from tests that use small and medium-size instruction mixes, along with either the floating-point calculation test or the coprocessor test (depending on the availability of a math coprocessor).

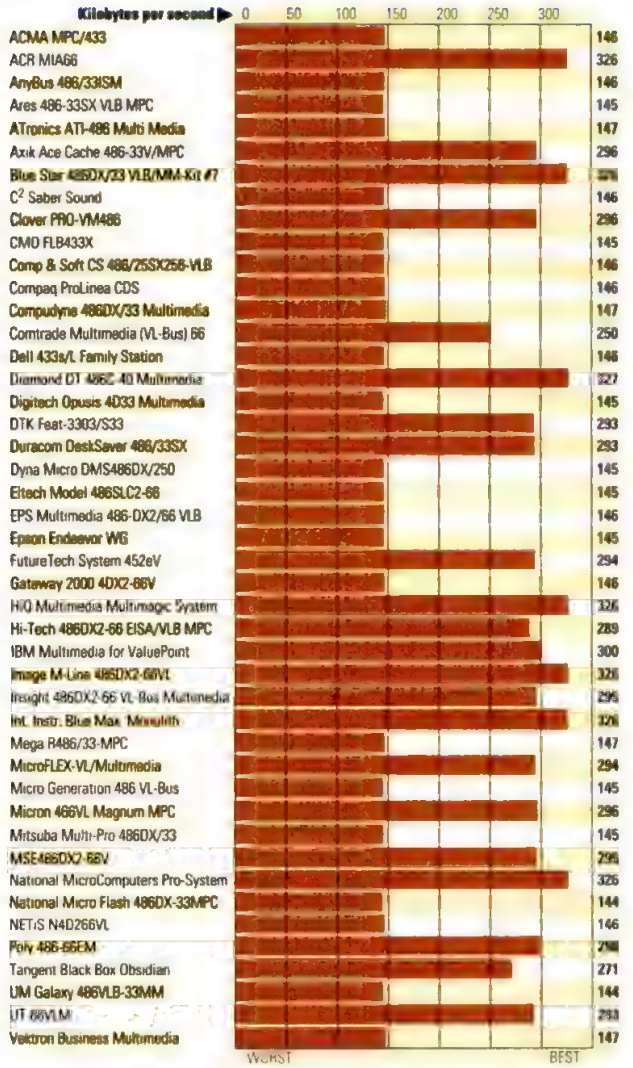
The **memory** score is compiled from 8-, 16-, and 32-bit extended-memory and 8- and 16-bit conventional-memory read and write tests.

The **video** score is based on direct-to-screen text- and graphics-write tests.

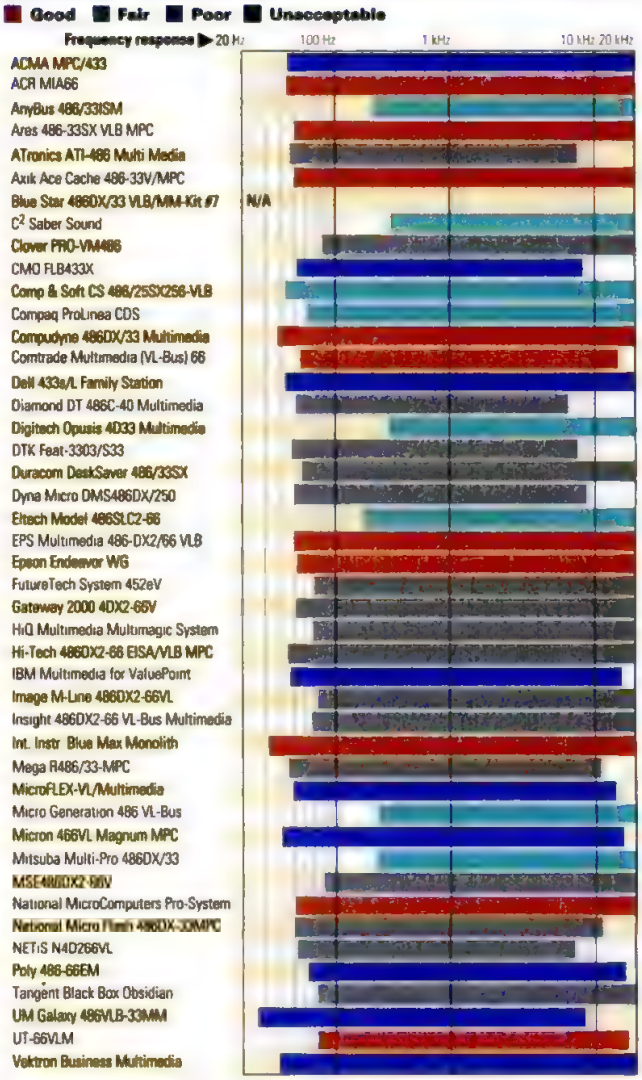
The **disk** score measures throughput using standard DOS INT 21h file I/O calls. The tests measure the speed of file reading and writing, both sequentially and randomly, for file sizes ranging from 256K to 32MB. The tests are performed without software disk caches installed.

The **DOSmark** is a composite rating derived from the processor, memory, video, and disk scores. It indicates a PC's ability to run DOS programs.

CD-ROM THROUGHPUT



OVERALL SOUND QUALITY



N/A—Not applicable. The Blue Star system operates only as a preamp.

The **Graphics Winmark** score is based on 12 Windows graphics and text functions that are derived from extensive profiling of popular Microsoft Windows applications. The score is measured in megapixels per second (a megapixel is 1,048,576 pixels).

The **Disk Winmark** score reflects disk operations under Windows. Systems are configured with up to 2MB of SmartDrive software cache.

In the **Windows Applications** suite, portions of four programs—Ami Pro, CorelDRAW, Microsoft Excel, and Superbase—are run via a macro and are timed. Because the results are given in seconds, lower scores represent better performance.

The **CD-ROM Throughput** tests use disk-read algorithms from our Hardware Benchmark Tests, Release 7.0, with a 160MB file in 16K blocks, a common block pattern used by software developers.

For **Sound Quality** testing, we used an Audio Precision Series One analyzer (APSO) and a CBS CD of calibrated tones. Three tests were run to measure total harmonic distortion (THD), signal-to-noise ratio (S/N ratio), and frequency response. We initially calibrated each system so that a 1-kHz signal on the CBS test CD would result in a power output of 1 watt or 0.5 watts. Any equalization controls in the mixer software were defeated. The resulting signal was analyzed using the APSO.

To measure THD, we fed the same 1-kHz tone through the sound board, with spurious harmonic products added to the output signal by the sound board and the CD-ROM recorded as a percentage. To determine the S/N ratio, we compared the CD's infinity-silence passage with each system's noise floor. Finally, a glide tone was used to measure each subsystem's ability to reproduce the full spectrum of human hearing (20 Hz to 20 kHz). Each horizontal bar on the chart represents the effective range of each system, before response dips or rises more than 3 dB from the reference point. The color of each bar represents the system's overall sound-quality result, which takes the THD, S/N ratio, and frequency response into account.

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RUNS LIKE LIGHTNING

September 1993
466VL MAGNUM

January 26, 1993
466 MAGNUM

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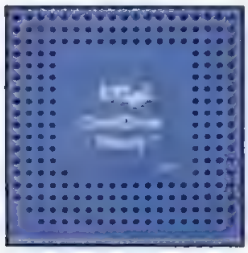

Standard on every Micron system is a Zero Insertion Force (ZIF) socket that makes upgrading to Intel's Pentium™ based OverDrive™ processors a snap! Heat's not a problem — Micron systems comply with Intel's stringent thermal dissipation guidelines.

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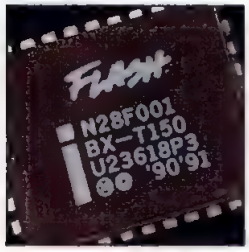
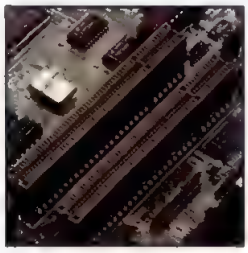


With 256K of ultra-fast Micron 15ns SRAM cache, your system's memory architecture will fully exploit future OverDrive processors. Plus, the upgradeable Flash BIOS lets you update your firmware from a floppy drive or modem.

VESA LOCAL BUS W/BLOCK MODE



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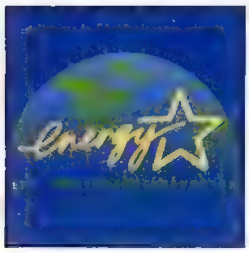

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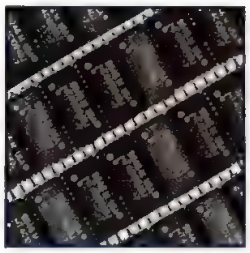

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that incorporate speakers into the system unit box, as did the units from ACMA Computers and National Micro Systems. This arrangement takes internal space away from expansion slots and bays and limits flexibility in terms of placing the speakers at the right distance and angle to the listener.

PC SPEAKERS

Speakers for a PC present extremely different problems than speakers for a home stereo do. They must be self-powered because the amplifiers on sound boards aren't powerful enough to drive speakers. Also, they must be shielded to keep their magnets from distorting the images on your monitor should you put them near your display. And getting top-flight speakers may alienate your neighbors in a business setting; cubicles just aren't soundproof. The solution is short-range speakers like the $100 Altec Lansing ACS50. These attach to the sides of your monitor, and an 8-foot range makes them perfect for offices without walls.

POTENT COMBINATION

The integration of sound board and CD-ROM drive is the most significant pairing of components. Vendors assembling multimedia PCs have a wide range of component choices, but the selection process is more complicated than simply choosing Chinese-restaurant style: one from column A and one from column B. Carelessly mix and match and audio performance can suffer if either of the components underperform.

We examine overall audio performance and report a composite sound-quality number that integrates the three most important determinants of audio quality. Total harmonic distortion (THD) levels below 0.1 percent indicate clean, undistorted output. Signal-to-noise ratio results above 65 decibels indicate subsystems with imperceptible noise levels. And frequency response that covers the range of human hearing (20 Hz to 20 kHz) with a modest amount of attenuation at low and high frequencies is acceptable. None of the units that we looked at received an excellent sound rating, and too many of them were rated unacceptable.

The systems with the best sound performance came from ACR Systems, Ares Microdevelopment, Axik Computer, Compudyne, Comtrade, EPS Technologies, Epson Direct, International Instrumentation, National MicroComputers, and Unitek Technology. All of those systems used the Media Vision Pro AudioSpectrum 16 or Creative Labs Sound Blaster board. But it was the combination of CD-ROM and sound board that counted most. The Epson Endeavor WG paired the Sony CDU31A-02 CD-ROM drive with a Media Vision Pro AudioSpectrum 16 board with good results, but the Insight 486DX2-66 VL-Bus Multimedia coupled the same board with a Texel DM-3024 CD-ROM with poor results.

When it comes to CD-ROM drives, we recommend double-speed drives, which double the throughput of the older single-speed drives and give a sustained data-transfer rate of 300K per second. The next level in CD-ROM speeds is triple- and quadruple-speed drives, which will bring data throughput to nearly the level of hard disks. Pioneer is the first company to offer a system with a quadruple-speed drive. Texel and others will reportedly have products with quadruple-speed drives shipping by year end.

The promise of improved sight and sound on desktop PCs will soon make multimedia an everyday reality.

With many advances coming, the state of multimedia PCs appears to be similar to that of television in the late 1940s. Crude, lacking in standardization, and with a dearth of quality programming, TV was once no more than a technological curiosity. Just as a decade of maturation and the creation of quality programming gave television the boost that it needed, the promise of improved sight and sound on desktop PCs will soon make multimedia an everyday reality.

ACMA Computers Inc.

ACMA MPC/433

Priced almost $1,000 less than many competing systems in this roundup, the $1,895 ACMA MPC/433 is a solidly constructed 486SX/33-based PC with quality components and no glaring faults.

Our tested unit came in a desktop case with a set of built-in speakers and rear-mounted audio/microphone jacks (optional external speakers are available). The company also installed a Creative Labs Sound Blaster 16 sound card and a single-speed Matsushita CD-ROM drive.

ACMA MPC/433

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	POOR

Two external 5.25-inch half-height drive bays and two 3.5-inch bays are complemented by one internal 5.25-inch bay. ACMA included a 210MB Conner IDE hard disk that uses 256K of hardware cache with this system, but storage can be upped to 2GB. The MPC/433's motherboard (made by USA Integration) was accessible, with 128K of processor cache. The Weitek coprocessor socket was buried beneath the drive bay assembly, however. Also, all the SIMM memory banks were used to provide the system's 8MB of RAM. To upgrade this, you'll have to swap the eight single-megabyte SIMMs for new ones of larger capacity.

ACMA's video subsystem relies on the VL-Bus version of the Diamond Stealth 24 adapter. With its 1MB of dedicated dynamic RAM and S3 86C805 graphics accelerator, this card boasts resolutions of up to 1,280-by-1,024 with 256 colors. The system's monitor is the 14-inch ADI MicroScan 3E+, a previous Editors' Choice recipient.

The MPC/433 performed adequately, though generally in the bottom third, on our benchmark tests. Its Matsushita single-speed CD-ROM drive managed mid-range throughput, but its slightly low-voltage output hampered the Sound Blaster's performance. Overall sound quality for this system was poor.

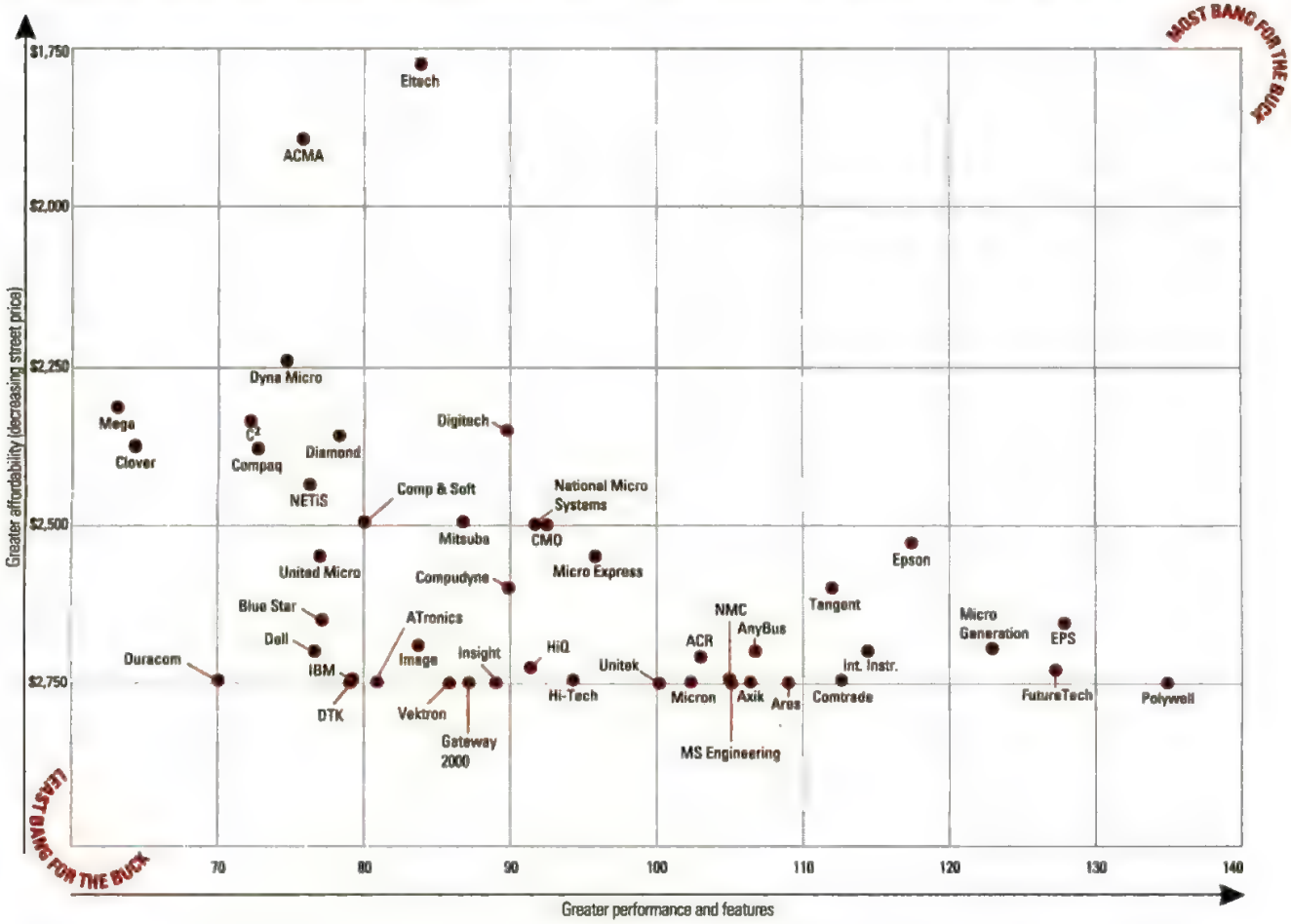
Price/Performance Index: *Multimedia PCs*

The bottom line for this roundup of 45 mainstream multimedia systems is this: If you're looking for quality sound reproduction and CD-ROM capabilities in a solid all-around personal computer, you'd better be ready to pay for them. None of the 45 systems that we reviewed fall within the optimum quadrant of our price/performance chart. Although list prices range from $1,779 for the Eltech system to our price ceiling of $2,750, which is hit by systems from MS Engineering, Unitek Technology, and Vektron International, no machine managed to resolve the inevitable conflicts between price and performance satisfactorily.

The systems with the best mix of performance and features had high prices to match, including the EPS Multimedia 486-DX2/66 VLB, the FutureTech System 452eV, and the Poly 486-66EM. All three had solid test results, but the EPS system went a step further with an overall sound quality rating of ***good***. The others offer great expansion capabilities.

The system that gives the best overall performance in both general PC operations under DOS and Microsoft Windows and sound reproduction is International Instrumentation's Blue Max Multimedia Monolith. We selected it above machines with better price/performance scores because it combined a ***good*** sound rating with exceptional performance and features in a tower case for $2,699.

Most units are clustered in the lower left-hand quadrant, where a system's lack of performance and features goes hand in hand with a high price. This group includes the Compaq, Dell, Gateway, and IBM systems, among which the $2,379 Compaq ProLinea is the least expensive but also offers the least complete combination of performance and features. The other three units have somewhat higher scores but cost more.



THE DATA POINTS

The Bang for the Buck performance index reflects each machine's benchmark test scores, hard disk capacity, installed RAM, processor socket, flash BIOS, and expansion features such as local bus, 16550 Universal Asynchronous Receiver/Transmitter (UART) support, extended warranty, on-site service, and bundled software. The index also takes into account a system's overall sound quality and whether or not its CD-ROM is double-speed. Benchmark test scores are weighted to account for 65 percent of the performance index, while capacity and expansion features account for the remaining 35 percent. You can find more data in the Software Library of the Editorial Forum on PC MagNet as 18BANG.xls.

Prices are based on our tested configurations (as listed in each product's fact file).

FACT FILE

ACMA MPC/433

ACMA Computers Inc., 47988 Fremont Blvd., Fremont, CA 94538; 800-786-6888, 510-623-1212; fax, 510-623-0818

List price (tested configuration): $1,895.
Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache
Disk drives and controller: Conner CP-30204 12-ms 210MB IDE hard disk with 256K cache, Helm Engineering DC-2000 local-bus hard disk controller card, dual 1.2MB/1.44MB floppy disk drive.
Display: Diamond Stealth 24VL VL-Bus card video controller with 1MB dynamic RAM, ADI MicroScan 3E+ 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768
Software: DOS 6.0, Microsoft Windows 3.1, Lemmings, Microsoft Bookshelf, The San Diego Zoo Presents. . .The Animals!, Software Toolworks Multimedia Encyclopedia, one audio CD of customer choice.
In short: Priced nearly $1,000 lower than many other units here, the ACMA MPC/433 is an able PC but doesn't measure up on multimedia capabilities
441 ON READER SERVICE CARD

The unit's bundled software packages included Lemmings and Software Toolworks Multimedia Encyclopedia. A one-year parts-and-labor warranty is also included.—*Oliver Rist*

ACR Systems Inc.

ACR MIA66

ACR Systems' $2,708 ACR MIA66 comes with excellent components that deliver competitive Windows performance. But ACR's lack of attention to end-user friendliness makes this package less attractive than it could be.

Arriving in a mini-tower case, the MIA66 has room for four external drives and one internal drive. The hard disk, however, is placed in the last available front-accessible bay, requiring you to reposition this drive should you desire tape backup or another external media device.

The MIA66 is based on a VL/ISA-486SV2 motherboard with an Intel DX2/66 CPU. It has 256K of cache and two VL-Bus slots (beside five regular 16-bit slots). Though the board can hold up to 32MB of RAM, ACR used all the SIMM sockets to give us the requested 8MB. Should you ever want to upgrade RAM, you'll have to purchase all new SIMMs of higher capacity.

ACR MIA66

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	GOOD

On a component level, ACR pulled out all the stops. A local-bus UltraStor 34F SCSI controller with 32K of cache regulates the 240MB Seagate hard disk (with its own 256K of cache), while Diamond Computer Systems' Viper VLB adapter boasts 2MB of video RAM and the scorchingly fast Weitek Power 9000 chip. The Creative Labs Sound Blaster 16 ASP card was paired with a very quick Toshiba XM-3401B dual-speed CD-ROM drive; together they produced good sound quality. A dual-speed Pioneer drive is available for $700. ACR also included a pair of decent-quality Sony SRS-88 speakers, which cost an extra $120.

FACT FILE

ACR MIA66

ACR Systems Inc., 1038 Kiel Ct., Sunnyvale, CA 94089; 408-734-9795; fax, 408-734-9798

List price (tested configuration): $2,708
Memory and processor RAM cache: 8MB 60-ns SIMMs, 256K external cache
Disk drives and controller: Seagate ST3283N 12-ms 240MB SCSI hard disk with 256K cache, UltraStor Ultra 34F VESA local-bus hard disk controller card with 32K cache, 1.2MB and 1.44MB floppy disk drives
Display: Diamond Viper VLB VESA local-bus card video controller with 2MB video RAM, Optiquest 1500D 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768
Software: DOS 6.0, Microsoft Windows 3.1, Where in the World is Carmen Sandiego?, Encyclopedia for CD-ROM
In short: The DX2/66-based ACR MIA66 features a collection of excellent components that did best on our Windows benchmark tests. This unit's CD-ROM drive and sound card also performed well, producing good-quality sound. Unfortunately, this package isn't exactly end-user friendly
442 ON READER SERVICE CARD

Combined, these components lived up to our expectations, with the puzzling exception of the local-bus SCSI hard disk. Although a quality Windows performer, it showed below-average throughput under DOS. The ACR garnered the fourth-highest Windows video score but fell into the bottom quartile in DOS.

ACR includes a one-year parts, five-year labor warranty, with a two-year parts warranty on its motherboard.—*OR*

Anybus Technology Inc.

AnyBus 486/33ISM

The AnyBus 486/33ISM is a PC that doesn't easily fit into categories. By supporting three buses—the ISA bus, VL-Bus, and proprietary OPTiLocal bus—it provides decided flexibility. And with its competitive performance and large assortment of bundled CD-ROM titles, the system's $2,699 price tag is definitely appealing.

AnyBus 486/33ISM

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	FAIR
Multimedia	FAIR

We found that expansion space was limited by the system's slimline case. With a multimedia kit already installed, there is only one free drive bay and two free vertically mounted ISA slots. The AnyBus motherboard is capable of handling a larger case with more inter-

FACT FILE

AnyBus 486/33ISM

AnyBus Technology Inc., 2722 Michelson Dr., Irvine, CA 92715; 714-222-6007; fax, 714-222-6688.

List price (tested configuration): $2,699.

Memory and processor RAM cache: 8MB 80-ns SIMMs, 256K external cache

Disk drives and controller: Seagate ST3390A 12-ms 340MB IDE hard disk with 256K cache, CMS VESA I disk controller, dual 1.2MB/1.44MB floppy disk drive

Display: Compro AV3-VLB-IM-AC video controller with 1MB DRAM, Arche 2145 14-inch monitor with a 63-Hz refresh rate at 800-by-600

Software: DOS 6.0, Microsoft Windows 3.1, Media Pak (Mavis Beacon Teaches Typing, Software Toolworks Reference Library, Secret Weapons of the Luftwaffe, Software Toolworks Atlas Pack)

In short: The AnyBus 486/33ISM offers attractive flexibility, credible performance, a large assortment of bundled CD-ROM titles, and a decent price, and it is marred only by its poorly packaged manuals and low-end monitor.

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nal peripherals. System memory can be expanded to 64MB, and the external cache goes to 256K. A potential problem is that all the 486/33ISM's upgradable components (processor, RAM, cache, and so on) are located beneath a drive bay assembly that spans the entire case length.

Thunder Media's Thunder Audio Spectrum 16 sound card and Sony single-speed CD-ROM combined to elicit a fair sound rating. AnyBus also offers a Chinon America double-speed CD-ROM for an extra $735. The included Media Resources Classic 511 speakers provide only low-quality sound.

On our benchmark tests, the 486/33ISM scored high up in the pack. All scores were average or slightly above, and the local-bus-controlled Seagate 340MB hard disk managed especially high DOS and Windows disk scores. The Compro AV3-VLB-IM-AC local-bus video card managed to break into the top ten on DOS video and posted acceptable Windows graphics results.

Besides an external microphone, AnyBus provided a large variety of CD-based software. Titles included Mavis Beacon Teaches Typing, Secret Weapons of the Luftwaffe, and Software Toolworks Reference Library.

AnyBus offers a two-year parts-and-labor warranty with this system.—*OR*

Ares Microdevelopment Inc.

Ares 486-33SX VLB MPC

The $2,749 Ares 486-33SX VLB MPC is a rugged and roomy system with satisfactory performance results, an attractive monitor, and a great warranty.

Packaged in a medium-size tower, the VLB MPC holds ten drive bays. The unit's Micronics motherboard can hold up to 64MB of RAM and 256K of cache. Two out of eight expansion slots have VL-Bus extenders. Both are filled: one by the Diamond Stealth Pro VL graphics adapter with 1MB of video RAM and an S3 accelerator, the other by a Promise DC-2000 local-bus IDE hard disk controller. The Intel 486SX/33 processor sits in a ZIF (zero-insertion-force) socket that is P24T upgradable.

Ares 486-33SX VLB MPC

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	EXCELLENT
Multimedia	GOOD

The system's Mitsumi double-speed CD-ROM drive is wired to its own adapter, while the Media Vision Pro AudioSpectrum 16 sound card's SCSI connection is left untouched. Since its CD-ROM performance wasn't comparatively spectacular, this seems like a waste of a slot.

The unit produced variable but steady results across the spectrum on our benchmark tests. DOS video and memory scores were above average, while CPU and disk marks were below average.

The Media Vision sound card and the Mitsumi CD-ROM drive combination produced good sound results. Ares Microdevelopment offers for $280 a Toshiba CD-ROM drive that reduces access time. The Diamond adapter was a complement to the Philips monitor. This low-emission display provides a great picture, digital controls, and rear-mounted audio jacks that can hook up directly to your CD-ROM.

Bundled software includes the Diamond adapter's bundled Turbo DLD video drivers, HALO Desktop Imager, Monologue for Windows, and QA Plus. Ares engineers remote diagnostics into the system via a modem and QA Plus.

Ares provides a two-year parts and lifetime labor warranty, with on-site service available through GE.—*OR*

FACT FILE

Ares 486-33SX VLB MPC

Ares Microdevelopment Inc., 23660-A Research Dr., Farmington Hills, MI 48335; 800-322-3200, 313-473-0808; fax, 313-473-4450

List price (tested configuration): $2,749.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 64K external cache.

Disk drives and controller: Western Digital Caviar 2250 13-ms 250MB IDE hard disk with 128K cache, Promise DC 2000 hard disk controller card, dual 1.2MB/1.44MB floppy disk drive.

Display: Diamond Stealth Pro VL video controller with 1MB video RAM, Philips 1557 AS 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, HALO Desktop Imager, Monologue for Windows, QA Plus.

In short: The Ares 486-33SX VLB MPC provided solid if not stellar test results, given its use of a 486SX/33 processor. It gains points for its roomy case, high quality monitor, and solid warranty.

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ThinkPad 720C (486SLC2 50/25 MHz processor, 2 PCMCIA slots)

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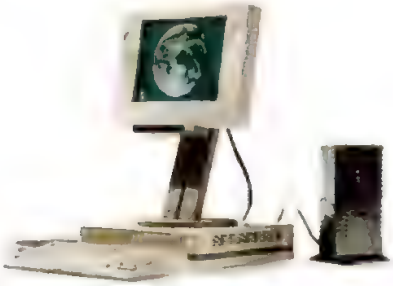

PS/2 E Energy Workstation (486SLC2 50/25 MHz processor, 4 PCMCIA slots)

ThinkPad 350C (486SL/25 MHz processor, 1 PCMCIA slot)

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ATronics International Inc.

ATronics ATI-486 Multi Media

ATronics International attempts to distinguish its $2,748 ATronics ATI-486 Multi Media by combining a DX2/66 processor, a huge tower case, a removable hard disk, and superfast Weitek-based Windows graphics. The result is a quality PC that falls short on multimedia tasks.

The ATI-486 can hold six external and three internal drives. Four of the external drives are taken by two floppy disk drives, the CD-ROM drive, and the removable Conner hard disk. The system battery is a rechargeable nickel cadmium, and all upgradable components are within easy reach.

Video is managed by an Orchid P9000/VLB adapter carrying the fast Weitek GUI accelerator and 2MB of video RAM. Wired to the Orchid is a CTX CP-5468NI monitor that provides adequate ergonomics and a decent VESA-compliant image. The 205MB IDE Conner hard disk is controlled by ATronics's own DC-50 VL-Bus controller, and storage can be upped to 1GB. But this controller doesn't provide floppy disk support, as that function runs off a separate 8-bit I/O card.

The ATI-486 managed fast performance, due in part to the DX2/66 CPU and Weitek graphics chip. DOS video scores were a bit below par, and the single-speed Panasonic CD-ROM drive's throughput numbers didn't dazzle. ATronics offers a higher-end Sony dual-speed CD-ROM as part of a $497 multimedia upgrade. The Creative Labs Sound Blaster Pro audio card seemed hampered by the CD-ROM drive's low-voltage output.

ATronics ATI-486 Multi Media

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	GOOD
Multimedia	POOR

The system included a pair of unmarked plastic speakers, which at 2 by 2 inches would look more appropriate next to a Walkman and sounded noticeably worse than most other PC speakers.

FACT FILE

ATronics ATI-486 Multi Media
ATronics International Inc., 45635 Northport Loop East, Fremont, CA 94538; 800-488-7776; 510-656-8400; fax, 510-656-8560.

List price (tested configuration): $2,748
Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache
Disk drives and controller: Conner CP-3204 15-ms 205MB IDE hard disk with 64K cache, ATronics DC-50 VL hard disk controller card, 1.2MB and 1.44MB floppy disk drives
Display: Orchid P9000/VLB VESA local-bus card video controller with 2MB VRAM, CTX 5468NI 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768
Software : DOS 6.0, Microsoft Windows 3.1, Indianapolis 500, the Simulation, King's Quest V, Lemmings, Microsoft Bookshelf, Microsoft Works for Windows, Mixed-Up Mother Goose, and other CD-ROM titles
In short: Solid Windows video action makes for a good overall PC, doing multimedia tasks only adequately
445 ON READER SERVICE CARD

Bundled software included Lemmings and Monologue for Windows. ATronics offers a one-year parts-and-labor warranty, with on-site service available for $65 a year.—*OR*

Axik Computer Inc.

Axik Ace Cache 486-33V/MPC

A good choice, the $2,748 Axik Ace Cache 486-33V/MPC is packaged in a massive tower case and offers better-than-average performance.

Holding nine drive bays, and with a 250-watt power supply, the Ace Cache could well be used as a file server with a CD-ROM drive. Though Axik Computer included TEAC America's dual-media floppy disk drive to save a bay, this really wasn't necessary. The bundled keyboard is a programmable Maxi Switch Pro. Our test unit was defective, however, with a loss of C-key usage and an occasional loss of Spacebar usage.

Axik Ace Cache 486-33V/MPC

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	EXCELLENT
Multimedia	GOOD

Sound is handled by a Media Vision Pro AudioSpectrum 16 card coupled with a double-speed Texel CD-ROM drive. A VL-Bus Orchid Fahrenheit 1280° Plus adapter handles graphics, while a VL-Bus Promise IDE controller

FACT FILE

Axik Ace Cache 486-33V/MPC
Axik Computer Inc., 268 Santa Ana Court, Sunnyvale, CA 94086; 800-234-2945; 408-735-1234; fax, 408-735-1437

List price (tested configuration): $2,748
Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache.
Disk drives and controller: Quantum ProDrive LPS 240AT 15-ms 234MB IDE hard disk with 256K cache, Promise Technology DC-4030VL hard disk controller card with 1MB cache, and a dual 1.2MB/1.44MB floppy disk drive
Display: Orchid Technology Fahrenheit 1280 Plus video controller with 1MB DRAM, ADI Systems MicroScan 3E+ 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768
Software: DOS 6.0, Microsoft Windows 3.1, Compton's Multimedia Encyclopedia
In short: The Axik Ace Cache 486-33V/MPC tower multimedia system offers the demanding personal computer user superb CD-ROM and disk performance that results in a quality package
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talks to the hard disk with the benefit of 1MB of hardware cache. And the bundled, VESA-compliant 14-inch ADI MicroScan 3E+ does its job nicely.

The Ace Cache's Intel 486DX/33 processor sits in a 238-pin P24T-capable ZIF socket, and its external RAM cache is upgradable to 256K. Memory tops out at 32MB, however. Out of the seven 16-bit ISA slots, two have VL-Bus extensions, and both are occupied.

System documentation neglects to include information about the system as a whole and doesn't seem aimed at beginners, but every component's technical manual is included. Axik included with the test unit the CD-ROM version of Compton's MultiMedia Encyclopedia and a catalog from New Media Source—a large CD-ROM mail-order house.

The Ace Cache's performance was quite good, with CD-ROM-throughput and disk scores running high. The CD-ROM drive's competence aided the sound card; system sound quality was good. Axik sent along a pair of Sony SRS-58 speakers.

Axik offers a one-year parts-and-labor warranty, with on-site service included.—*OR*

Blue Star Marketing Inc.

Blue Star 486DX/33 Series II VLB/MM-Kit #7

The $2,649 Blue Star Marketing entry carries all the features seen in competing models but goes a step farther by including a Sony CD-ROM drive, which posted quite exceptional test scores.

Blue Star 486dx/33 Series II VLB/MM-Kit #7

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	GOOD
Multimedia	POOR

The Blue Star 486DX/33 Series II VLB/MM-Kit #7's medium-tower case holds eight drive bays, five of which are external. The Tyan motherboard holds two 8-bit, three 16-bit, and two VL-Bus slots. The last two are taken by Diamond Computer Systems' Viper video adapter (holding the very powerful Weitek Power 9000 chip and 2MB of video RAM) and a Tyan VL-Bus IDE hard disk controller that does double duty as an I/O port controller. RAM can grow to 32MB, and the external cache size can be increased all the way to 1MB. The bundled monitor had "Blue Star" stenciled across the bezel, but it is actually a 14-inch CTX-CMS-1461.

Performance was average. DOS video and disk scores were slightly below par, but video scores soared under Windows, and Windows disk scores toed the line nicely as well. The Sony drive was the third-best performer on our CD-ROM throughput test. But the system's Sonic Sound audio board lacked an on-board power-amp circuit, so it couldn't perform our Frequency Response test—hence this system's unacceptable sound quality rating.

FACT FILE

Blue Star 486DX/33 Series II VLB/MM-Kit #7

Blue Star Marketing Inc., 2312 Cantral Ave. N.E., Minneapolis, MN 55418; 800-950-8884, 612-788-5000; fax, 612-788-3442

List price (tested configuration): $2,649

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Seagate 2383A 12-ms 249MB IDE hard disk with 128K cache, Tyan VESA local-bus hard disk controller card, and 1.2MB and 1.44MB floppy disk drives.

Display: Diamond Viper VESA local-bus card video controller with 2MB VRAM, CTX 1461 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Microsoft Windows 3.1, HALO Desktop Imager, Macromind Action 2.5, Mavis Beacon Teaches Typing, Microsoft Works, Reference Library, Secret Weapons of the Luftwaffe, and other titles.

In short: A competent addition to Blue Star's mainstream lineup, this system differentiates itself by providing one of the best CD-ROMs available.

447 ON READER SERVICE CARD

The Blue Star ships with several software titles. Titles we saw included Compton's MultiMedia Encyclopedia, HALO Desktop Imager, MacroMind Action, Mavis Beacon Teaches Typing, Microsoft Windows Works, and Secret Weapons of the Luftwaffe.

Blue Star's five-year warranty has certain conditions. It covers neither the monitor nor the bundled CD-ROM/sound-card subsystem, which carry one-year warranties. And you pay 20 percent of parts and labor needed in the second year. This number increases by 20 percent each year thereafter.—*OR*

C^2 Micro Systems Inc.

C^2 Saber Sound

C^2 Micro Systems uses an IBM 486SLC2/50 motherboard processor and Thunder Media's Thunder Audio Spectrum 16 sound board to place the C^2 Saber Sound's price tag at $2,335—a little lower than its peers'. But some below-average performance scores may send you back up the price scale.

The Saber Sound's desktop case holds three external drive bays and one internal bay. Though the case has a pair of speakers, quality is lacking, and we suggest buying an external set. The Saber Sound's keyboard has a nice feel, but the keyboard-mounted trackball may take some getting used to.

C^2 Saber Sound

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	FAIR

The IBM-made Alaris motherboard is cleanly laid out, but the placement of processor and memory banks beneath the drive assembly could make upgrading a headache. There are five 16-bit slots, one 8-bit slot, and two VL-Bus slots. The use of an ISA expansion-card disk controller and not the local bus is disappointing. The 15-inch Hyper VGA III monitor is not up to date ergonomically, with few image controls and a rear-mounted power switch. But it provides decent picture quality.

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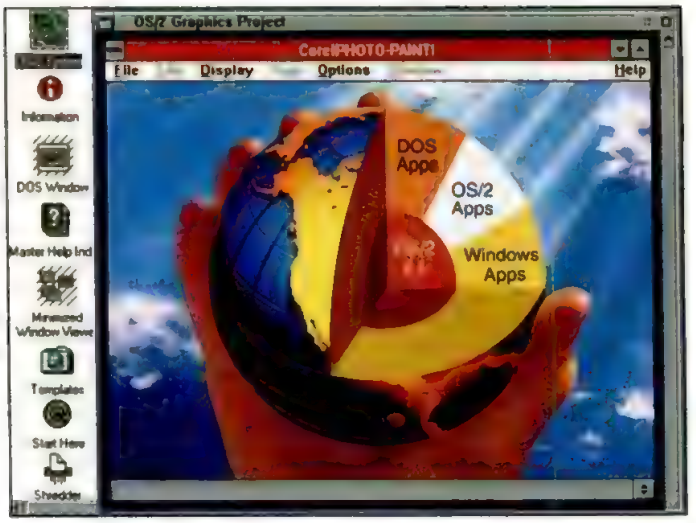

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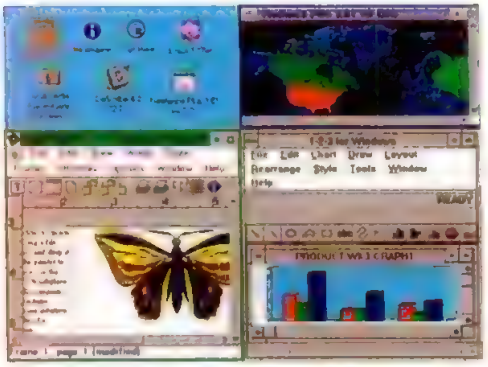

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FACT FILE

C² Saber Sound

C² Micro Systems Inc., 47560 Seabridge Dr., Fremont, CA 94538; 510-683-8888; fax, 510-683-8662

List price (tested configuration): $2,335.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 64K external cache.

Disk drives and controller: Maxtor 7213A 13-ms 212MB IDE hard disk with 256K cache, Kouwell KW-556N ISA hard disk controller card and 1.2MB and 1.44MB floppy disk drives.

Display: Diamond Stealth 24VL VESA local-bus card video controller with 1MB DRAM, and Shamrock SRC 1501 15-inch monitor with a 70-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Microsoft Windows 3.1, HALO Desktop Imager, Sequencer Plus Junior, Thunder Media Stereo CD-ROM music software

In short: With an IBM-engineered and manufactured motherboard, the C² Saber Sound is an excellent entry-level system for those on a budget.

448 ON READER SERVICE CARD

Multimedia components include the Thunder sound card and the Mitsumi single-speed CD-ROM drive. Both were average performers and produced fair-quality sound. C² sells for $260 a Chinon 535D dual-speed CD-ROM.

The unit performed adequately, though not as well as it should have, given its processor. It suffered from a slow memory subsystem and posted below-average disk scores under DOS and Windows.

C² bundled with the test unit HALO Desktop Imager, Sequencer Plus Junior, and the Diamond DLD AutoCAD drivers included with the Diamond Stealth 24VL card.

C² offers a one-year parts-and-labor warranty, with on-site service included.—*OR*

Clover Computer Systems Inc.

Clover PRO-VM486

The $2,375 Clover PRO-VM486 is priced a little lower than its peers and had mostly below-average test scores and an awkward design.

The Clover's medium-size tower case holds five drive bays and allows clear access to the 486DX/33 CPU and the system's memory subsystem. The Contaq 486-VL motherboard places the processor in a standard socket and includes 256K of cache and eight expansion slots (two with VESA VL-Bus extenders). It can hold up to 32MB of system memory.

Clover Computer Systems unfortunately chose to go with a VL-Bus three-in-one card that runs drive-controller circuitry, video circuitry, and all I/O ports through a single VESA slot. The I/O ports were then run off the card and out the rear expansion bracket of the neighboring VESA slot.

Though configured competitively with a Cirrus Logic video chip and 1MB of video RAM, all this data exchange running through a single card affected performance: DOS video scores were slightly below average, and DOS and Windows disk numbers were well below the norm. Windows video scores landed second from the bottom. The combination of the dual-speed Texel CD-ROM drive and the Media Vision Pro Audio-Spectrum 16 card produced clipping, which led to an unacceptable sound-quality rating. Clover offers a Toshiba double-speed drive for $150.

Clover PRO-VM486

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	POOR

A bright spot was the wedge-shaped Acoustic Research AR-570 speakers sent with the system. An additional $349, they rated among the best.

You can choose 3 CD-ROM titles from a list of 25. For review, Clover included Authorware Star, MacroMind Action!, and Multimedia World Atlas.

Most disappointing in general was the skimpy, poorly organized documentation. Clover includes a one-year parts-and-labor warranty with the system, with on-site service available at no extra charge.—*OR*

FACT FILE

Clover PRO-VM486

Clover Computer Systems Inc., 1430 Loll Circle, #102, San Jose, CA 95112; 800-925-6837, 408-436-0444; fax, 408-436-0494

List price (tested configuration): $2,375.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache.

Disk drives and controller: Maxtor LXT7213A 13-ms 213MB IDE hard disk with 64K cache, Clover VESA Local-Bus 3-in-1 VESA local-bus hard disk controller card and 1.2MB and 1.44MB floppy disk drives.

Display: Clover VESA Local-Bus 3-in-1 video controller with 1MB video RAM, ADI 3E 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, Authorware Star, MacroMind Action, and other CD-ROM titles.

In short: Even though it costs less than many other machines in this roundup, the Clover PRO-VM486 is marred by a do-it-all expansion card and poor sound quality.

449 ON READER SERVICE CARD

CMO Micro Systems

CMO FLB433X

The $2,499 CMO FLB433X distinguished itself with a strong disk showing. It posted weak video scores, however, and its sound card gave it some trouble.

A standard desktop case holds five drive bays and a 200-watt power supply. The internal drive bay assembly gives the system a sturdy feel but also conceals the CPU and memory banks, making upgrades difficult.

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AGFA

The Shuttle-409 motherboard proved quite competitive. It can hold up to 32MB of RAM and 256K of cache and features seven expansion slots, including two VL-Bus extensions. The strong disk subsystem comprises a 527MB IDE Conner hard disk and an ATC controller. While this doubles as the source for the I/O ports, the ports are wired out the back of a neighboring expansion slot, effectively blocking that slot. Video is based around an Addonics Technology monitor and a MachSpeed VGA GUI 2000 adapter running a Cirrus Logic video chip set with 1MB of dynamic RAM.

CMO FLB433X

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	FAIR
Multimedia	POOR

This configuration enabled the CMO to score well on our DOS graphics and DOS and Windows disk tests. On the other hand, the CMO produced the fourth-lowest Graphics Winmark score in this roundup.

The Mitsumi single-speed CD-ROM performed decently for its class, and CMO MicroSystems offers a double-speed Toshiba drive for an additional $308. The Aztech Sound Galaxy NX Pro sound card unfortunately suffered from numerous technical difficulties during testing. Once running, however, it produced acceptable tones through the Persona PC speakers CMO sent. We rated the sound quality poor.

Also included with the CMO is a microphone, Guinness Disc of Records, Macmillan Dictionary for Children, and Software Toolworks World Atlas.

The unit carries a one-year parts-and-labor warranty; on-site service is not available.—*OR*

FACT FILE

CMO FLB433X

CMO Micro Systems, 101 Reighard Ave., Williamsport, PA 17701; 800-233-8950, 717-327-9200; fax, 717-327-1217

List price (tested configuration): $2,499

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Conner 30544 10-ms 527MB IDE hard disk with 256K cache, ATC 2270VL hard disk controller card, 1.2MB and 1.44MB floppy disk drives.

Display: MachSpeed VGA GUI 2000 video controller with 1MB DRAM, Addonics MON-C143 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, Guinness MultiMedia Disc of Records, Jones in the Fast Lane, Macmillan Dictionary for Children, Where in the World is Carmen Sandiego?, and other CD-ROM titles.

In short: Despite its attractive price and strong hard disk performance, the CMO FLB433X's weak video scores and sound card were definite problems.

450 ON READER SERVICE CARD

Comp & Soft Experts

CS 486/25SX256-VLB

The $2,495 CS 486/25SX256-VLB carries the same feature set found in most of the other units in this roundup. But despite these similarities, the Comp & Soft Experts system delivers below-average performance—for a similar price even after discounting its 486SX/25 CPU.

CS 486/25SX256-VLB

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	GOOD
Multimedia	FAIR

The Comp & Soft System is housed in a mini-tower case that contains four external drive bays and one internal bay. Comp & Soft's motherboard carries all the essentials: 256K of cache, up to 32MB of RAM, two 8-bit and four 16-bit ISA slots, and two VL-Bus slots. The processor in the unit we saw was in a nonupgradable socket, and SIMM memory was full—meaning you'll have to buy a whole new set if you need more RAM. The two VL-Bus slots were filled by an Orchid Fahrenheit VA/VLB video board based around an S3 chip and an AddTech IDE2SPG local-bus hard disk controller with 64K of cache.

FACT FILE

CS 486/25SX256-VLB

Comp & Soft Experts, 12011 St. Charles Rock Rd., St. Louis, MO 63044; 800-327-8486, 314-298-1900; fax, 314-298-9674

List price (tested configuration): $2,495.

Memory and processor RAM cache: 8MB 70-ns SIMMs 256K external cache.

Disk drives and controller: Seagate ST3243A 16-ms 214MB IDE hard disk with 64K cache, AddTech IDE2SPG hard disk controller card with 64K cache, dual 1.2MB/1.44MB floppy disk drive.

Display: Orchid Fahrenheit VA/VLB video controller with 1MB DRAM, ViewSonic 6E 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, HSC Interactive, Monologue for Windows, PC Animate, Software Toolworks Multimedia Encyclopedia.

In short: Comp & Soft supplies competitive features, including VESA VL-Bus video and hard disk connections, but overall performance simply wasn't up to par

451 ON READER SERVICE CARD

Naturally, the Intel 486SX/25 processor had trouble keeping up with the 486DX/33 and 486DX2/66 processors most of the other systems carried. But the Comp & Soft also posted below-average memory and subpar DOS and Windows video numbers. The combination of the AddTech hard disk controller and the 214MB IDE Seagate hard disk fared no better, resulting in below-average DOS and Windows disk results.

The Comp & Soft came equipped with a single-speed Mitsumi CD-ROM drive and a Creative Labs Sound Blaster 16 ASP sound board. The CD-ROM drive managed competitive throughput numbers for its class. The Sound Blaster also

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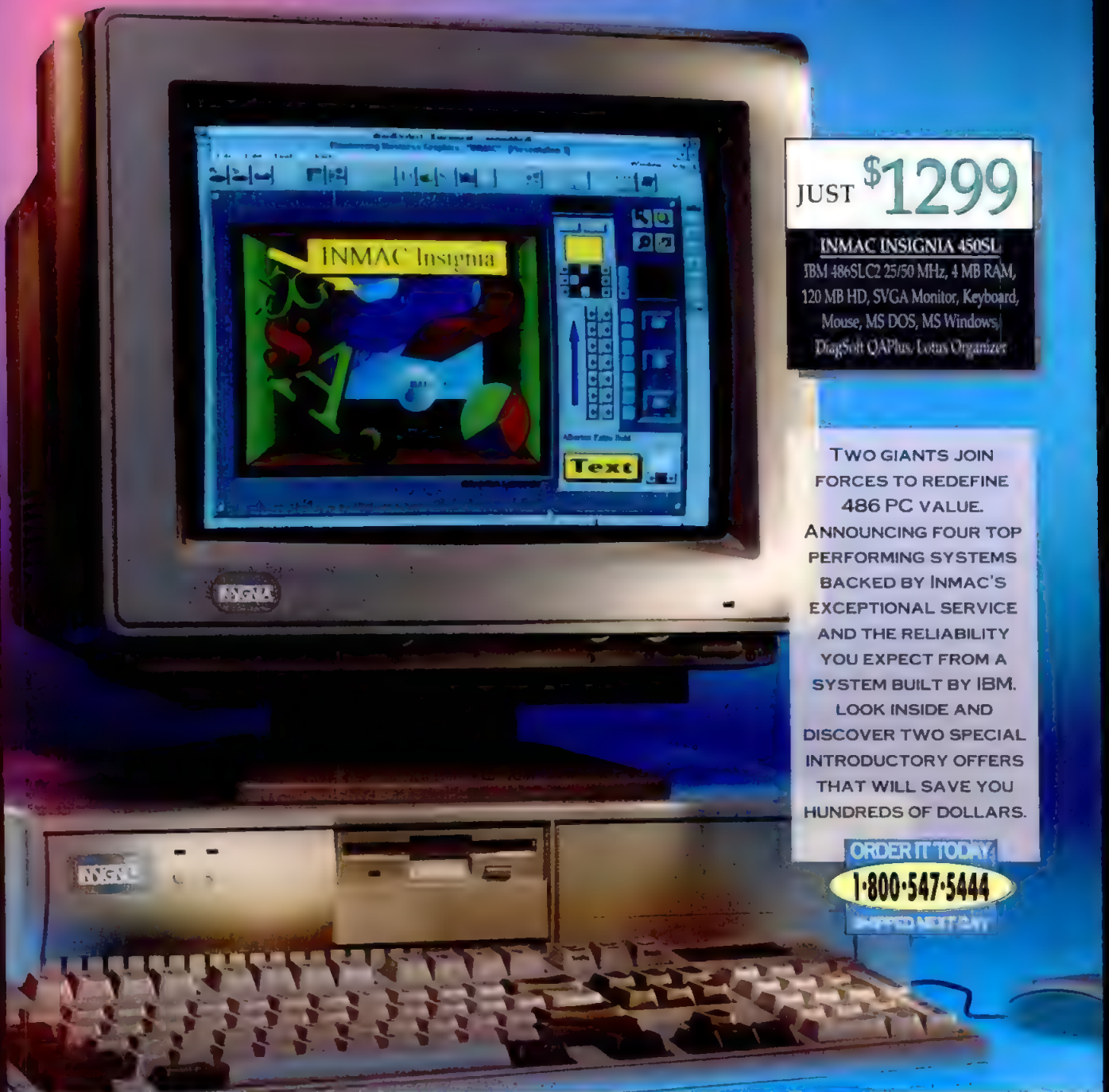

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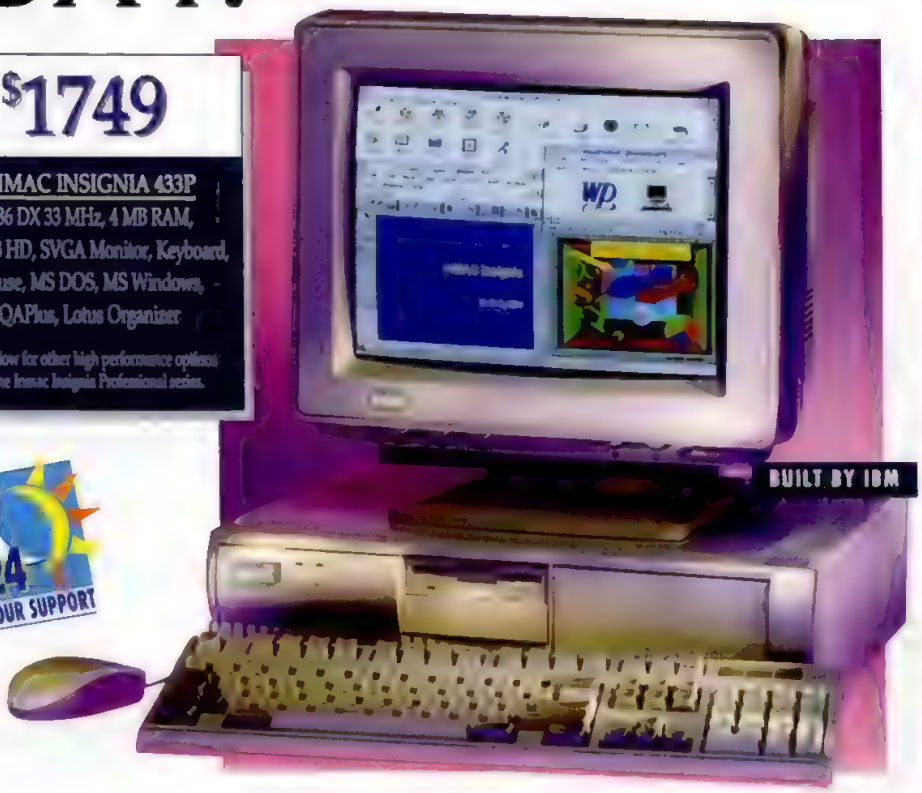

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- Upgradeable to Pentium Technology

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- Paradox for Windows
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SYSTEM

The systems below are preconfigured with four drive bays; five ISA expansion slots; two serial ports; one parallel port; keyboard; mouse; MS DOS; MS Windows; DiagSoft QAPlus; Lotus Organizer.

1 ☐ **INMAC INSIGNIA 450SL** IBM basic system with IBM 486SLC2 25/50 MHz CPU; 16 KB internal cache

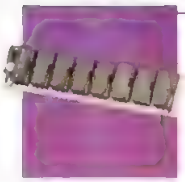
2 ☐ **INMAC INSIGNIA 433P** basic system with Intel 486 DX/33 MHz CPU; 8 KB Write-thru cache

3 ☐ **INMAC INSIGNIA 450P** basic system with Intel 486 DX2/50 25/50 MHz CPU; 8 KB Write-thru cache

4 ☐ **INMAC INSIGNIA 466P** basic system with Intel 486 DX2/66 33/66 MHz CPU; 8 KB Write-thru cache

RAM

(Check one)



5 ☐ **4 MB**

6 ☐ **8 MB**

7 ☐ **16 MB**

8 ☐ **32 MB**

9 ☐ **64 MB** (not available on 450SL)

MONITORS/VIDEO

10 ☐ **SVGA Monitor 14", .28 1024 x 768 NI**

11 ☐ **SVGA Monitor 17", .28 1024 x 768 NI**

12 ☐ **ORCHID Fahrenheit 1280* SVGA Video Accelerator**

DRIVES/SCSI ADAPTER

HARD DRIVE *(Check one)*

13 ☐ **120 MB**

14 ☐ **170 MB**

15 ☐ **255 MB**

16 ☐ **340 MB**

17 ☐ **540 MB***

FLOPPY DRIVE *(Must check dual or 3.5")*

18 ☐ **DUAL FLOPPY DRIVE 3.5" & 5.25"** (single drive bay)

19 ☐ **3.5" FLOPPY DRIVE**

20 ☐ **5.25" FLOPPY DRIVE** (as second drive)

21 ☐ **SCSI ADAPTER**

** Requires SCSI adapters.*

SOFTWARE

We will install the latest version available at time of shipment.

WORD PROCESSING

22 ☐ **MICROSOFT WORD FOR WINDOWS**

23 ☐ **WORDPERFECT FOR WINDOWS**

24 ☐ **LOTUS AMI PRO FOR WINDOWS**

SPREADSHEETS/FINANCE

25 ☐ **MICROSOFT EXCEL FOR WINDOWS**

26 ☐ **LOTUS 1-2-3 FOR WINDOWS**

27 ☐ **BORLAND QUATTRO PRO FOR WINDOWS**

28 ☐ **MS MONEY**

DATABASE MANAGEMENT

29 ☐ **BORLAND PARADOX FOR WINDOWS**

PRESENTATION GRAPHICS

30 ☐ **MICROSOFT POWERPOINT FOR WINDOWS**

31 ☐ **LOTUS FREELANCE FOR WINDOWS**

UTILITIES

32 ☐ **CENTRAL POINT PC TOOLS FOR WINDOWS**

INTEGRATED OFFICE APPLICATIONS

33 ☐ **MICROSOFT OFFICE:** Word, Excel, PowerPoint, Mail

34 ☐ **LOTUS SMART SUITE:** Ami Pro, 1-2-3, Freelance, cc:Mail

35 ☐ **BORLAND OFFICE:** WordPerfect, Quattro Pro, Paradox

NETWORKING

36 ☐ **3COM ETHERLINK III COMBO** (AUI, TP, BNC)

37 ☐ **IBM 4/16 ISA TOKEN RING ADAPTER**

38 ☐ **INTERNAL 9600/2400 FAX/MODEM**

39 ☐ **INTERNAL 14.4 K BAUD FAX/MODEM**

MULTIMEDIA

40 ☐ **INTERNAL CD-ROM DRIVE**

41 ☐ **CREATIVE LABS SOUND BLASTER***

42 ☐ **CREATIVE LABS VIDEO BLASTER***

43 ☐ **MEDIA VISION PRO AUDIO SPECTRUM 16***

**Hardware included*

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performed very well, given the Mitsumi drive's low-voltage output. This unit's sound quality was fair.

One of the Comp & Soft's attractive features was its ViewSonic 6E monitor. This 14-inch display is fully VESA-compliant, with a 0.28-mm dot pitch and a good picture.

Comp & Soft supplies a one-year parts, five-year labor warranty, with on-site service available for $149 the first year.—*OR*

Compaq Computer Corp.

Compaq ProLinea CDS

The $2,379 Compaq ProLinea CDS combines satisfactory performance and high-quality components and packaging with Compaq Computer Corp.'s name and warranty policy. On the downside, multimedia components nearly fill the system's slimline case, and Compaq's local-bus QVision video couldn't keep up under Windows.

Based around an Intel 486SX/25 processor, the ProLinea's slimline case contains everything you need today but leaves no space for anything else. All drive bays are filled, and you're left with only two vacant 16-bit slots. Based on a proprietary local bus, Compaq's integrated video scheme uses a Tseng ET4000 chip set that was slow under Windows but competitive under DOS. On the other end is Compaq's superb 14-inch monitor, with a 72-Hz refresh rate at 1,024-by-768.

Compaq ProLinea CDS

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	POOR
Multimedia	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Elsewhere, performance was relatively competitive for a 486SX/25-based unit, though not outstanding when compared with PCs with more-capable CPUs. Memory, processor, and Windows disk scores were average when compared with the scores of the other SX/25 units in this roundup, while DOS disk scores were above average. The LMSI single-speed CD-ROM managed average data throughput. (Compaq offers a Sony dual-speed CD-ROM drive for an additional $479.) Equipped with a Media Vision Audio-Spectrum 16 sound card, the ProLinea achieved a fair sound-quality rating.

The rest of the system comprises Koss minispeakers (which are included in the price) and a built-in 2,400-/9,600-bps internal modem. Bundled software we saw included Mayo Clinic Family Health Book, Interactive Edition; Micrografx Graphics Works, Limited Edition; a Prodigy start-up kit; and Where in the World is Carmen Sandiego?

Added to that is an attractive three-year parts-and-labor warranty, with one year of on-site service.—*OR*

FACT FILE

Compaq ProLinea CDS

Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-370-0670; fax, 713-378-1442

Estimated selling price (tested configuration): $2,379.

Memory and processor RAM cache: 8MB 70-ns SIMMs

Disk drives and controller: Quantum ProDrive LPS 240AT 16-ms 244MB IDE hard disk with 256K cache, integrated IDE disk controller, 1.44MB floppy disk drive

Display: Integrated video controller with 1MB DRAM, Compaq 1024 Color model 461 14-inch monitor with a 72-Hz refresh rate at 1,024 by 768

Software: DOS 6.0; Microsoft Windows 3.1; Compton's Interactive Encyclopedia for Windows; PFS Windows Works 2.0; Prodigy; Mayo Clinic Family Health Book, Interactive Edition; Micrografx Graphics Works, Limited Edition; WinFax UltraLITE; and Where in the World is Carmen Sandiego?, Deluxe Edition

In short: The Compaq ProLinea provides adequate performance, a built-in modem, and a large variety of CD titles for a low price tag

452 ON READER SERVICE CARD

Compudyne

Compudyne 486DX/33 Multimedia System

Compudyne, the house brand for CompUSA computer superstores, has put together what looks on paper like a good combination of components for a multimedia system. Unfortunately, performance of the $2,599 Compudyne 486DX/33 Multimedia System disappointed in this field already crowded with similar systems.

Compudyne 486DX/33 Multimedia

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

A standard desktop case holds three front-accessible 5.25-inch half-height drive bays and one internal 5.25-inch bay. On top rests the Labtec CS1000 Multimedia PC speaker module, a $100 option. This square box has two small low-grade speakers, headphone jacks, and volume and tone controls.

Compudyne has sensibly run all I/O, floppy disk, and IDE hard disk circuits off the motherboard, not off a card, which appears to be the exception in this roundup. Most of the motherboard is easily accessible, and although the CPU socket is standard (not a ZIF socket), it has the 238 pins necessary for a Pentium upgrade.

Though video is controlled by a Diamond Viper board equipped with the legendary Weitek Power 9000 chip and 2MB of video RAM, benchmark test scores for this board were far below average. Scoring over 40 megapixels per second in some systems we tested, the same card in the Compudyne managed only slightly over 24 megapixels per second. The integrated IDE controller also failed to measure up, but its excuse was lack of local-bus access.

The single-speed Matshusita CD-

FACT FILE

Compudyne 486DX/33 Multimedia System

Compudyne, 15167 Business Ave., Dallas, TX 75244; 800-862-3099, 214-702-0055; fax, 214-888-5743.

List price (tested configuration): $2,599

Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache.

Disk drives and controller: Maxtor 7245AT 15-ms 245MB IDE hard disk with 64K cache, integrated IDE disk controller, dual 1.2MB/1.44MB floppy disk drive.

Display: Diamond Viper VLB video controller with 2MB VRAM, Compudyne KD-1450T 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Microsoft Windows 3.1, Compton's Interactive Encyclopedia, Jazz: A Multimedia History, Family Choice, U.S. Presidents, The Doctor's Book of Home Remedies, and other CD titles

In short: Though Compudyne's multimedia system provides good sound quality, its benchmark test scores fell short of their potential.

453 ON READER SERVICE CARD

ROM drive managed average scores, and the Creative Labs Sound Blaster 16 audio card did well. The system achieved a good sound-quality rating.

The Compudyne comes bundled with Compton's MultiMedia Jazz, Compton's Interactive Encyclopedia, Family Choices, The Doctor's Book of Home Remedies, and U.S. Presidents.—*OR*

Comtrade

Comtrade Multimedia (VL-Bus) 66

Comtrade has packed a high-performance 486DX2/66-based multimedia machine into a $2,745 package, making the Comtrade Multimedia (VL-Bus) 66 a system of merit.

A roomy desktop case carries five drive bays but conceals one of the Comtrade's few design faults—poor hard disk placement. If you need to reach the hard disk, you'll have to remove the drive bay assembly and the 200-watt power supply. Since this system had four more accessible bays, this placement is questionable.

The motherboard has it all: 256K of cache, integrated I/O ports, and eight expansion slots that include three 16-bit ISA, three 32-bit EISA, and two VESA VL-Bus slots. These last two are filled, one by a Morse VL-Bus hard disk controller, and the other by a Lazer VL-Bus Super VGA adapter. The Intel DX2/66 processor was easy to reach, but it isn't in an upgradable ZIF socket, and it's covered by a bulky heat sink.

Comtrade Multi-Media (VL-Bus) 66

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	FAIR
Multimedia	GOOD

The Lazer adapter is hooked to a CTX CMS-1461 multiscan monitor that provides good ergonomics with a decent picture. Multimedia components include the Media Vision Pro AudioSpectrum 16 card and an NEC double-speed CD-ROM drive. Comtrade also sent a pair of low-quality Discwasher 250 speakers, available for $50.

Test performance was impressive. Across the board, the Comtrade managed above-average results, and DOS video marks were exceptionally good. The NEC CD-ROM drive, however, did not perform as well in this machine as it did elsewhere in this roundup, and throughput scores fell below the drive's data-transfer rating. Comtrade offers a $100 dual-speed Toshiba drive. The Media Vision sound card was an above-average performer in its class, helping it secure a good sound-quality rating.

Comtrade includes several software titles with this system and offers a three-year parts and lifetime labor warranty. On-site service costs $30 a year.—*OR*

FACT FILE

Comtrade Multimedia (VL-Bus) 66

Comtrade, 15314 E. Valley Blvd., City of Industry, CA 91746; 800-969-2123, 818-961-6688; fax, 818-369-1479.

List price (tested configuration): $2,745.

Memory and processor RAM cache: 8MB 60-ns SIMMs, 256K external cache

Disk drives and controller: Western Digital WD Caviar 2250 12-ms 250MB IDE hard disk with 64K cache, Morse VL-Bus disk controller card with 64K cache, and 1.2MB and 1.44MB floppy disk drives.

Display: Lazer VL-Bus SVGA video controller with 1MB DRAM, CTX CMS-1461/LR 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Microsoft Windows 3.1, ChessMaster 3000 Multimedia, Mavis Beacon Teaches Typing, and other Software Toolworks titles.

In short: Excellent general PC performance is coupled with good sound quality, making the Comtrade Multimedia system a quality choice.

454 ON READER SERVICE CARD

Dell Computer Corp.

Dell 433s/L Family Station

The $2,699 Dell 433s/L Family Station offers a strong combination of features, including extensive software and clear, well-presented documentation. But the unit's disk performance is lacking, and its slimline case is a drawback for those seeking a system that can grow.

The pizza-box-style case is well made with multiple internal plastic support beams, but it only holds three drive bays—all of which are filled. The motherboard contains three 16-bit ISA expansion slots, one filled and none supporting VESA local-bus extensions. On the other hand, the motherboard is nicely integrated, offering I/O ports, IDE and floppy connections, and even local-bus video based around a Tseng ET4000/W32 chip set and 1MB of dedicated dynamic RAM. It also supports up to 128K of cache and 64MB of RAM. The bundled

14-inch Dell UltraScan monitor is fully VESA-compliant, with support for resolutions up to 1,024-by-768. System memory is easy to reach for do-it-yourself upgrades, and though the main 486SX/33 processor is soldered onto the motherboard, a P24T upgrade socket is provided.

Overall, performance was adequate. Video, which earned above-average scores under both DOS and Windows, was the high point. The low point was the 245MB IDE Maxtor hard disk, which couldn't match the competition.

The installed Matsushita single-speed CD-ROM drive suffered from a slow access time but managed average throughput for its class. The Creative Labs Sound Blaster 16 ASP audio card managed decent numbers, but sound quality was poor.

Dell Computer Corp. also included a pair of Peavey Mediavoice speakers (which sell for $120), as well as several software packages. Titles we saw included Cinemania, Micrografx Draw, and Quicken for Windows.

Available direct and via retail channels, the unit is covered by a one-year parts-and-labor warranty; on-site service is included.—*OR*

Dell 433s/L Family Station

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	POOR
Multimedia	POOR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	BELOW AVERAGE
Technical support	ABOVE AVERAGE

FACT FILE

Dell 433s/L Family Station

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400; fax, 512-343-3643

List price (tested configuration): $2,699

Memory and processor RAM cache: 8MB 70-ns SIMMs

Disk drives and controller: Maxtor 7245AT 15-ms 245MB IDE hard disk with 64K cache, integrated disk controller, and 1.44MB floppy disk drive.

Display: Integrated local-bus video controller with 1MB dynamic RAM, Dell UltraScan 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768

Software: DOS 6.0; Microsoft Windows 3.1; Cinemania; Mayo Family Health Book; Micrografx Draw, Limited Edition; Microsoft Bookshelf for Windows 1.0; Multimedia Microsoft Works for Windows 1.0, Quicken for Windows 2.0

In short: The unit's slow disk performance marred what would have otherwise been a superior multimedia package

455 ON READER SERVICE CARD

Diamond Technologies Inc.

DT 486C-40 Multimedia

Based on Cyrix 486 S-40 silicon, Diamond Technologies' $2,359 DT 486C-40 Multimedia is a product that has packed a lot of performance and features into a low-cost package. Unfortunately, the system is plagued by unacceptable sound quality.

A roomy medium-size tower case holds seven drive bays and a 230-watt power supply. The internal space allows plenty of access to the motherboard. This component holds up to 32MB of RAM, 256K of cache, five ISA slots, and three VL-Bus slots. A Promise Technology DC-4040VL-1 hard disk controller carries 2MB of cache and neighbors a Cardex W32 VESA video card with a Tseng ET4000/W32 graphics chip.

I/O is run off its own card, and an extra external SCSI port runs out the rear of the CD-ROM drive controller. A 14-inch CTX CMS-1461 monitor is included.

The Cyrix processor managed performance equivalent to that of an Intel 486SX/33. While DOS video managed an above-average score, the Graphics Winmark score was below average, but disk scores were near the top under DOS and well into the above-average range under Windows. Diamond also included a hot Toshiba 200-ms double-speed CD-ROM drive. Unfortunately, it was paired with a Creative Labs Sound Blaster Pro audio card, which produced clipping and led to unacceptable sound quality.

Diamond offers an extensive software bundle for an additional $120. Titles include Software Toolworks Multimedia Encyclopedia, Software Toolworks Reference Library, and Software Toolworks World Atlas.

The unit sells mainly through the direct channel and includes a 15-month parts, 2-year labor warranty. There's a $75 charge for on-site service.—*OR*

DT 486C-40 Multimedia

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD
Multimedia	POOR

FACT FILE

DT 486C-40 Multimedia

Diamond Technologies Inc., 1275 S. Lewis St., Anaheim, CA 92805; 800-989-7253, 714-533-9910; fax, 714-533-7805

List price (tested configuration): $2,359

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Conner CP30254H 12-ms 251MB IDE hard disk with 128K cache, Promise Technology DC-4030VL-1 VESA local-bus hard disk controller card with 2MB cache, 1.2MB and 1.44MB floppy disk drives

Display: Tseng Cardex W32 VESA local-bus card video controller with 1MB DRAM, CTX CMS-1461/LR 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1

In short: Diamond Technology's entry offers middle-of-the-road performance and features. The unit's quality CD-ROM drive was hampered by poor sound quality from its sound board

456 ON READER SERVICE CARD

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Hardware Review, United Feature Syndicate

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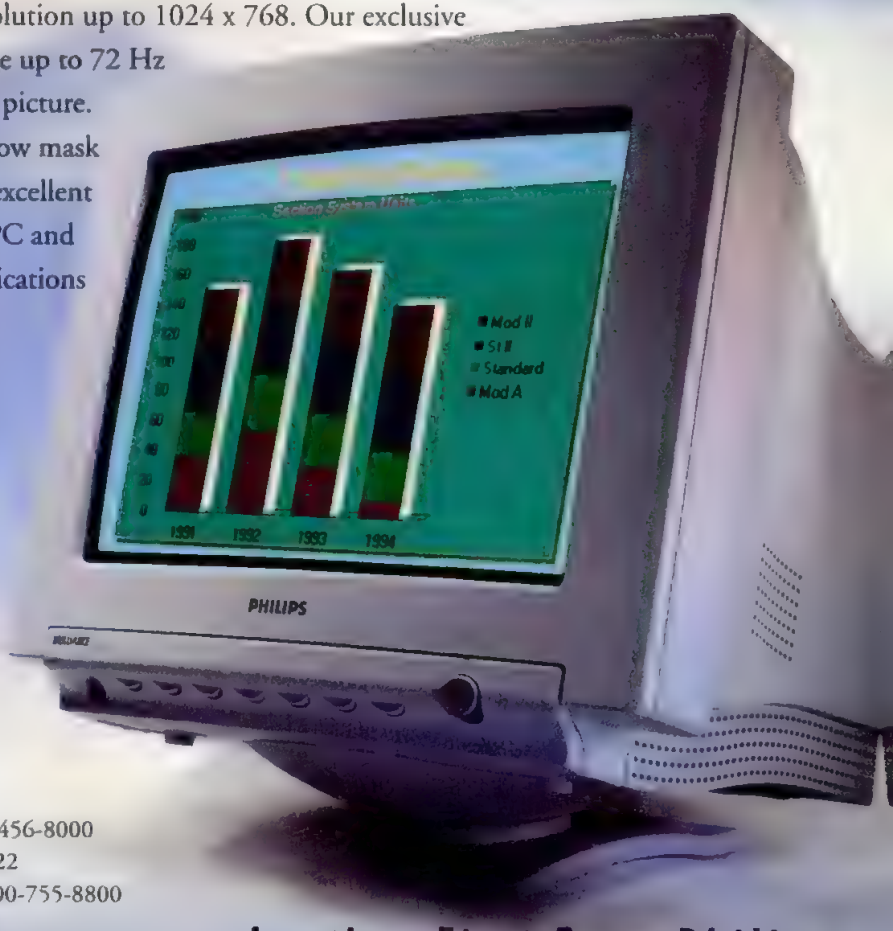

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CIRCLE 246 ON READER SERVICE CARD

Digitech Research Inc.

Digitech Opusis 4D33 Multimedia System

The $2,350 Digitech Opusis 4D33 Multimedia System offers a variety of attractive features, including VESA local-bus peripherals and a 16-bit sound card, but its uneven performance disappointed.

Digitech Opusis 4D33 Multimedia Systems

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	EXCELLENT
Expandability	FAIR
Multimedia	FAIR

The Opusis's desktop case contains four drive bays, as well as two internal stereo speakers. These speakers are encased in large, black plastic tubes—an unsuccessful attempt to enhance bass frequency response. The front panel includes volume, microphone, and headphone jacks. Unfortunately, the left speaker interferes slightly with expansion-card insertion and removal, and the processor is hidden beneath the drive bay assembly. The bundled 14-inch MGC 1406 monitor is VESA-compliant with good image quality.

The motherboard can carry up to 32MB of RAM and 256K worth of external cache. Besides four ISA expansion slots, you'll also find three VESA VL-Bus slots. One is filled by an S3-based Actix GraphicsEngine 32VL graphics adapter, and another by a MicroStar MS-3802 hard disk controller, which doubles as the I/O controller. The ports are wired out the back of the last VESA slot, limiting the use of this third local-bus slot.

Test performance was generally in the below-average-to-average range. DOS video and Windows disk numbers were slightly above average, but processor, memory, DOS disk, and Windows video marks were all below average. This system's single-speed Mitsumi CD-ROM drive produced average throughput. Digitech Research offers a double-speed Toshiba CD-ROM drive for $400. Thunder Media's Thunder Audio Spectrum 16 sound card had acceptable frequency-response scores, and sound quality was fair.

FACT FILE

Digitech Opusis 4D33 Multimedia System

Digitech Research Inc., 376 Lemon Creek Dr., Unit F, Walnut, CA 91789; 800-949-5018, 909-468-1368; fax, 909-468-1366

List price (tested configuration): $2,350
Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache
Disk drives and controller: Western Digital Caviar 2200 15-ms 210MB IDE hard disk with 64K cache, Microstar MS-3802 VESA local-bus hard disk controller card, 1.2MB and 1.44MB floppy disk drives
Display: Actix Systems GE32VL VESA local-bus card video controller with 1MB DRAM, MGC 1406 14-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024
Software: DOS 6.0, Microsoft Windows 3.1, King's Quest V, Microsoft Bookshelf, Microsoft Works, Music Box, Sequencer Plus Junior
In short: The Digitech Opusis Multimedia is offered at a low price, but its spotty performance makes it less appealing
457 ON READER SERVICE CARD

The software bundle we saw consisted of a CD-ROM music controller from Thunder Media and Sequencer Plus Junior. A two-year parts-and-labor warranty completes the package.—*OR*

DTK Computer Inc.

DTK Feat-3303/S33

The DTK Feat-3303/S33 gives solid performance for an SX/33-based machine and has good expansion options. But it can't handle the demands of rudimentary multimedia uses and at $2,749 is not priced at a level corresponding to its entry-level sound performance.

Equipped with a Maxtor 240MB hard disk, a Promise IDE controller with a whopping 4MB of cache, a Diamond Viper VESA video controller with 2MB of RAM, and a standard 256K of external RAM cache, the DTK does well on paper. These components are responsible for the unit's good showing on a number of our benchmark tests, bringing its disk performance in Windows and DOS to above-average and earning it an excellent Windows graphics score. Aside from its below-average DOS VGA scores, the

DTK Feat-3303/s33

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	GOOD
Multimedia	POOR
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

FACT FILE

DTK Feat-3303/S33

DTK Computer Inc., 17700 Castleton St., 160, City of Industry, CA 91748; 800-289-2385, 818-810-8880

List price (tested configuration): $2,749
Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache
Disk drives and controller: Maxtor MX7245 15-ms 240MB IDE hard disk with 64K cache, Promise DC-4030VL VESA local-bus hard disk controller card with 4MB cache, 1.2MB and 1.44MB floppy disk drives.
Display: Diamond Technologies Viper (Version 2.0) VESA local-bus card video controller with 2MB VRAM, ADI Microscan Low Radiation 4G 15-inch monitor with a 72-Hz refresh rate at 1,280-by-1,024
Software: DOS 6.0, Microsoft Windows 3.1, Autodesk Animation Player, Autodesk Multimedia Explorer, Compton's MultiMedia Encyclopedia
In short: The DTK Feat-3303/S33 is a solid SX/33 computer, but the package doesn't hold up as a true multimedia system
458 ON READER SERVICE CARD

DTK's performance remained decidedly average on the rest of our tests.

The sound system didn't fare as well. The Creative Labs Sound Blaster Pro sound card produced clipping and had an unacceptably low cutoff in the high-frequency range. DTK Computer sent us low-cost Labtec CS-150 speakers, which did not improve matters. The company offers them for an additional $49. But the CD-ROM was a Texel DM-3024, a solid double-speed drive that produced acceptable throughput levels. Sound quality, however, was rated as unacceptable.

The system's expansion capabilities are good, but its DTK motherboard can't handle more than 32MB of RAM. The desktop case has five accessible and two internal drive bays and one 8-bit slot, four 16-bit slots, and two VESA slots.

The DTK came with a selection of educational software. Titles included Compton's MultiMedia Encyclopedia.

There's a one-year parts-and-labor warranty, with on-site service available from GE for $50.—*Anush Yegyazarian*

Duracom Multimedia DeskSaver 486/33SX

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	FAIR
Multimedia	POOR

Duracom Computer Systems

Duracom Multimedia DeskSaver 486/33SX

The Duracom Multimedia DeskSaver 486/33SX performed capably as an SX/33-based computer but failed to meet the audio demands of a true multimedia system. Though it offers good expansion options, the system is not priced as competitively as others in this roundup.

The $2,745 DeskSaver came with 256K of external RAM cache, a Western Digital Caviar 212MB drive, a Duracom VESA disk controller with 2MB of cache, and an ATI Graphics Ultra Pro video controller with 1MB of video RAM. This combination gave it mostly average performance on our tests, with highs in DOS VGA and disk performance and lows in processor and memory performance.

NEC's double-speed CD-ROM drive produced good throughput levels, and Duracom Computer Systems offers the higher-performing Toshiba XM-3401 CD-ROM drive for an additional $50. Among the best here, a set of Altec Lansing ACS 300 speakers (with separate subwoofer) were included with our test unit, but they cost an additional $319. The Media Vision Pro AudioStudio 16 produced clipping and had a below-average signal-to-noise ratio, making it unsuitable for true audio capabilities. Sound performance was deemed unacceptable.

The DFI motherboard can't handle more than 32MB of RAM on-board, but the rest of the expansion options are good. The desktop case offers four accessible and two internal drive bays, and it has two 8-bit, four 16-bit, and two VESA slots. The ZIF socket also makes upgrading the processor an easier task.

Duracom sent a variety of CD-ROM–based software with its system, including Compton's Interactive Encyclopedia, Battle Chess, and Civilization. A small microphone was also included.

The unit comes with a one-year parts-and-labor warranty, with free on-site service for the first year. In case of repair, Duracom pays for shipping.—*AY*

FACT FILE

Duracom Multimedia DeskSaver 486/33SX

Duracom Computer Systems, 1425 Greenway Dr., Irving, TX 75038; 800-551-9000, 214-518-1200; fax, 214-518-1090

List price (tested configuration): $2,745.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Western Digital Caviar 2200 15-ms 212MB IDE hard disk with 64K cache, Tekram DC680T disk controller with 2MB cache, 1.2MB and 1.44MB floppy disk drives

Display: ATI Graphics Ultra Pro video controller with 1MB VRAM, ADI MicroScan 3E 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Microsoft Windows 3.1, Battle Chess Enhanced, Compton's Interactive Encyclopedia, MacroMind Action!, Mayo Clinic Family Health Book

In short: Though a decent computer system, the Duracom doesn't fulfill all the requirements of a multimedia system

459 ON READER SERVICE CARD

Dyna Micro Inc.

Dyna Micro DMS486DX/250

The $2,240 Dyna Micro DMS486DX/250 comes well equipped and has the advantage of a low price, but its relatively low-performance CD-ROM drive and disappointing sound production are the system's shortcomings.

The Intel 486DX2/50-based Dyna Micro sports a decent feature set, a 212MB Conner hard disk, an Orchid Fahrenheit 1280° local-bus graphics accelerator, and a 14-inch FORA monitor capable of 1,024-by-768 resolution at a 70-Hz refresh rate. The desktop case features four accessible drive bays and one internal bay. There are also two VESA and five 16-bit expansion slots.

Dyna Micro DMS486DX/250

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	FAIR
Multimedia	POOR

The Dyna Micro's multimedia setup includes a single-speed Mitsumi CD-ROM drive and an Aztech Sound Galaxy NX Pro 16 sound board. Along with DOS 6.0 and Microsoft Windows 3.1, the package comes with a good selection of standard CD-ROM software, including educational and entertainment titles featured in Version 1.0 of Software Toolworks Deluxe Pack. The reviewed unit was supplied with $15 Multimedia CD Laser Station 55 speakers, not included in the system price.

Neither the CD-ROM drive nor the sound card delivered very good test performance. The throughput of the Mitsumi drive was among the slowest of the

One

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Toshiba T4600C	6.9	SL	33MHz	Yes
Compaq LTE Lite 4/33c	6.5	SL	33MHz	Yes
IBM ThinkPad 720C	7.6	SLC2	50MHz	No

the only family of 486-powered notebooks to have won five Editors' Choice awards in

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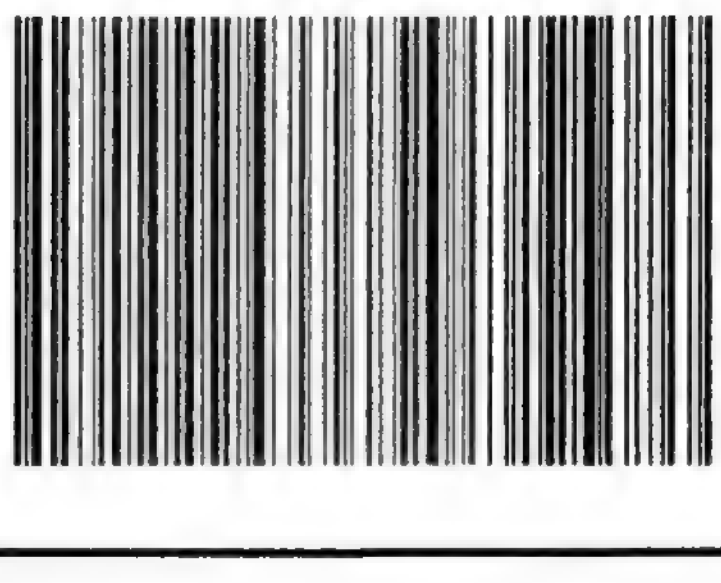

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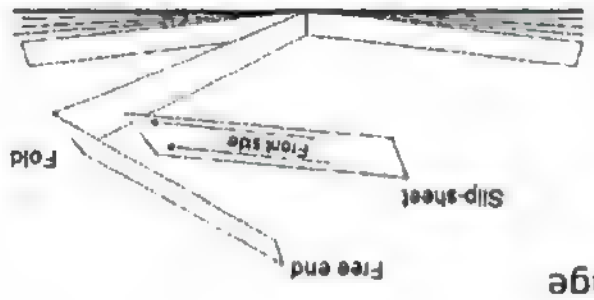

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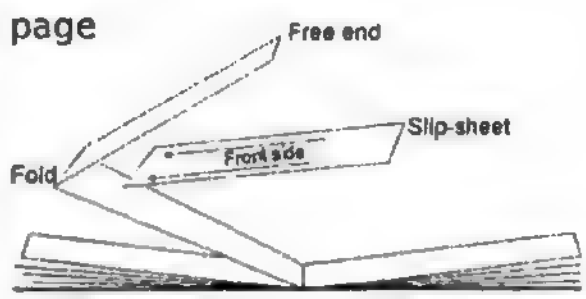

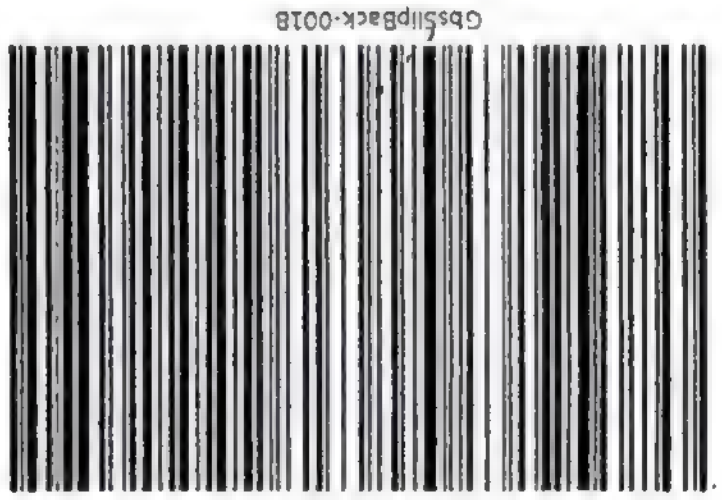

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Inverted Back

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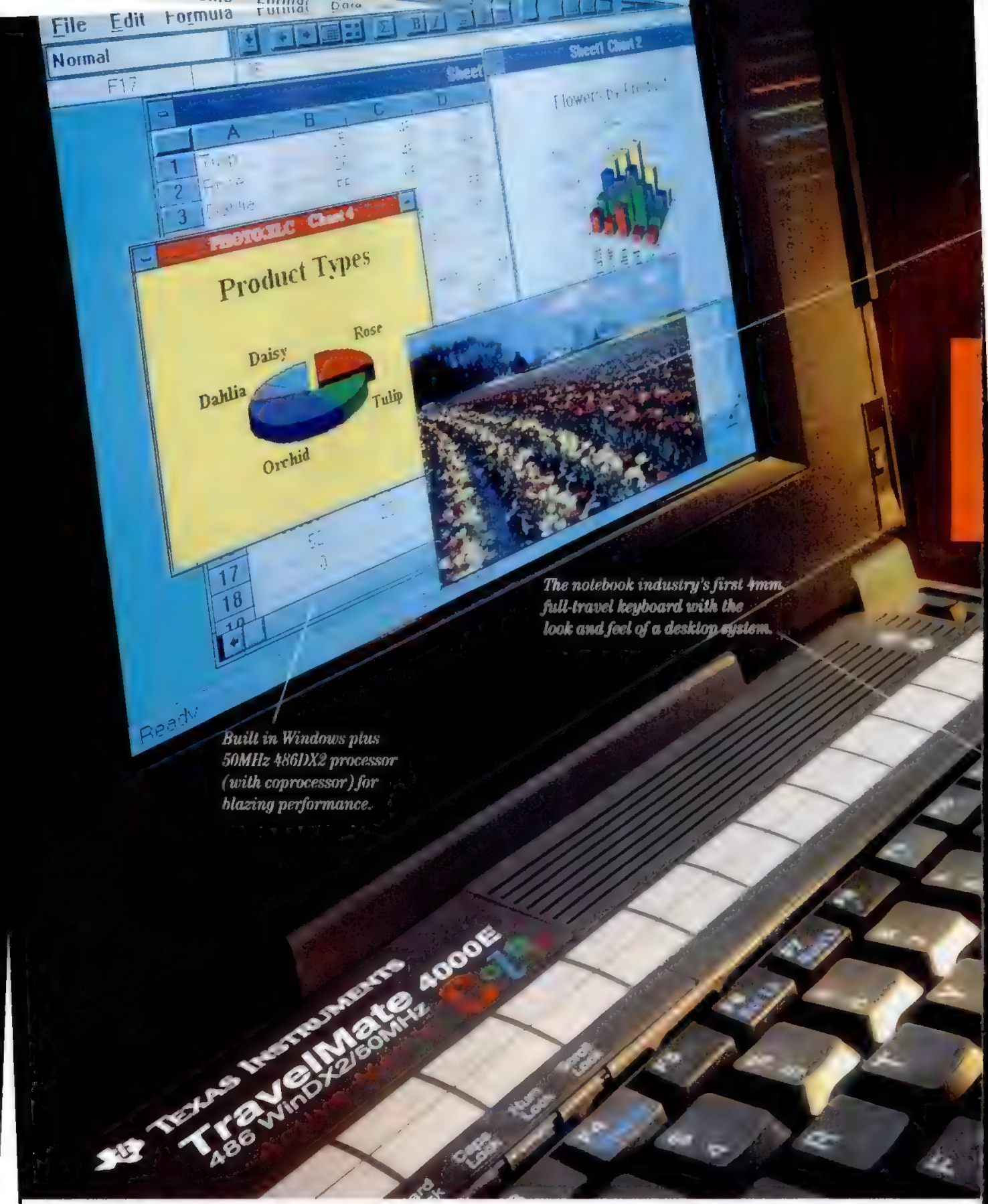

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*Based on industry standard application performance speed tests

intel inside

MICROSOFT WINDOWS READY TO RUN

single-speed drives, but the company offers a Texel double-speed drive for $170. The drive and board combined to earn an unacceptable sound-quality rating.

The Dyna Micro was a decidedly mediocre performer on our benchmark tests. The unit posted slightly below-average DOSmark, Graphics Winmark, Disk Winmark, and Windows Applications scores.

Sold direct and through dealers, the Dyna Micro comes with a one-year warranty, with a $150 charge for a year of on-site service.

In sum, this unit may have an appealing price tag, but it's a lackluster performer.—*Bruce Brown*

FACT FILE

Dyna Micro DMS486DX/250

Dyna Micro Inc., 30 West Montague Expwy., San Jose, CA 95134; 800-362-3962, 408-943-0100; fax, 408-943-0642

List price (tested configuration): $2,240

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Conner CP-30204 12-ms 212MB IDE hard disk with 256K cache, DFI MIO-500 disk controller, 1.44MB floppy disk drive.

Display: Orchid Fahrenheit 1280 Plus VESA local-bus card video controller with 1MB DRAM, Fora Addonics C142 SVGA 14-inch monitor with a 70-Hz refresh rate at 800-by-600.

Software: DOS 6.0, Microsoft Windows 3.1, The Software Toolworks Deluxe Pack, Version 1.0.

In short: The Dyna Micro DMS486DX/250 sports an appealing price tag of $2,240. It was only a mediocre performer on PC Labs' benchmark tests, however, and its multimedia components compared poorly with those of many systems reviewed. With only a single-speed CD-ROM drive, which was unable to generate a full watt of power, this unit's sound quality was deemed unacceptable

460 ON READER SERVICE CARD

Eltech Research Inc.

Eltech Model 486SLC2-66

It may lack any high-performance components, but Eltech Research's Eltech Model 486SLC2-66 is a good buy at $1,779, which is the lowest in this roundup. Based on a motherboard built by IBM and featuring an IBM clock-doubled 66-MHz 486SLC-2 processor, the Eltech can work well as a starter system.

Eltech Model 486SLC2-66

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	FAIR

The Eltech is equipped with 8MB of RAM; 128K of RAM cache; a Quantum 240MB IDE hard disk with 64K of cache; a Cirrus Logic chip–equipped, Alaris Tomahawk video board; and an Arone 14-inch monitor capable of 1,024-by-768 resolution at a 60-Hz refresh rate. The system uses Thunder Media's Thunder Audio Spectrum 16 sound card and a relatively slow Mitsumi CD-ROM drive. For $300, an NEC dual-speed CD-ROM drive is available. The sound board and CD-ROM drive together managed fair sound quality, although the unit's signal-to-noise ratio was only minimally acceptable. The test system came with low-power Labtec CS-150 speakers that cost an extra $20 and a small selection of reference, entertainment, and productivity CD-ROM disk software.

The mini-tower Eltech features six drive bays, eight expansion slots (which include two VESA slots), and 128K of RAM cache, but system memory is limited to 16MB of RAM. On our benchmark tests, scores clung to the middle of the pack; DOSmark, Graphics Winmark, Disk Winmark, and Windows Applications scores were average.

Eltech offers a three-year warranty on the motherboard and a one-year parts-and-labor warranty on the remainder of the system. On-site service through Computerland costs $69.

It's not a top performer, but considering its low price, we'd say the Eltech is a good deal for someone who just wants to get started in multimedia computing for the least amount of money. Overall system performance is impressive.—*BB*

FACT FILE

Eltech Model 486SLC2-66

Eltech Research Inc., 48890 Milmont Dr., #108D, Fremont, CA 94538; 800-358-8330, 510-438-0990; fax, 510-438-0663

List price (tested configuration): $1,779.

Memory and processor RAM cache: 8MB 80-ns SIMMs, 128K external cache.

Disk drives and controller: Quantum LPS-240AT 12-ms 240MB IDE hard disk with 64K cache, Alaris Patriot VESA local-bus hard disk controller card, 1.2MB and 1.44MB floppy disk drives.

Display: Alaris Tomahawk VESA local-bus card video controller with 1MB DRAM, Arone 214MH 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Microsoft Windows 3.1, King's Quest V, Microsoft Bookshelf, Microsoft Works for Windows 2.0, Mixed-Up Mother Goose, Sound Library.

In short: As an absolute entry-level multimedia system, the Eltech Model 486SLC2-66 is a decent buy CD-ROM performance is slow, but system performance is impressive.

461 ON READER SERVICE CARD

EPS Technologies Inc.

EPS Multimedia 486-DX2/66 VLB

The $2,655 EPS Multimedia 486-DX2/66 VLB produced good sound quality and fine system performance. The EPS's better-than-average components and exceptional service offering make this system stand out from the crowd.

Based on a 66-MHz Intel 486DX2 CPU, the EPS has 256K of RAM cache, 8MB of RAM, a 245MB Maxtor IDE hard disk with 64K of cache, a Promise disk controller card with 512K of cache,

a top-rated Diamond Viper VLB video card with 2MB of video RAM, and an EPS-label 15-inch 60-Hz monitor capable of 1,280-by-1,024 resolution.

The only shortcoming of this system is the data throughput of the single-speed Philips CD-ROM, which was slightly lower than specification. A dual-speed NEC drive is available for $299. The Media Vision Pro AudioSpectrum 16 multimedia sound card was a good performer with low distortion, relatively high signal-to-noise ratio, and good low- and high-frequency ranges. Along with better-than-average KOSS HD4 self-amplified speakers (included in the system price) and educational and entertainment CD-ROM disk titles, you get a full-performance system with good sound quality.

EPS Multimedia 486-DX2/66 VLB

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD
Multimedia	GOOD

The EPS system's scores were also above average on our DOSmark, Graphics Winmark, Disk Winmark, and Windows Applications benchmark tests.

Expansion possibilities are better than average. The EPS case houses four accessible and two internal drive bays and one 8-bit slot, three 16-bit slots, and three VESA local-bus slots. System memory is expandable to 32MB.

The EPS comes with a three-year parts and one-year labor warranty, with one year of on-site service and a 60-day money-back guarantee included.

Considering its sound quality, system performance, expandability, and service policies, we found the EPS to be a good buy.—*BB*

FACT FILE

EPS Multimedia 486-DX2/66 VLB

EPS Technologies Inc., 10069 Dakota St., Jefferson, SD 57038; 800-447-0921, 605-966-5586; fax, 605-966-5482.

List price (tested configuration): $2,655

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Maxtor 7245AT 15-ms 245MB IDE hard disk with 64K cache, Promise DC-4030VL VESA local-bus hard disk controller card with 512K cache, 1.2MB and 1.44MB floppy disk drives

Display: Diamond Viper VLB VESA local-bus card video controller with 2MB VRAM, EPS Technologies CM-536 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024

Software: DOS 6.0, Microsoft Windows 3.1, CD Speedway, ChessMaster 3000, EPS E-Cache, Mavis Beacon Teaches Typing, Software Toolworks Atlas Pack, Software Toolworks Reference Library

In short: With above-average performance and sound quality and lots of included software, the EPS Multimedia 486-DX2/66 VLB is one of this roundup's bargains.

462 ON READER SERVICE CARD

Epson Direct

Epson Endeavor WG

At $2,529, Epson Direct's low-profile Epson Endeavor WG offers good value as an entry-level multimedia system. It combines a high-performing sound board with average-quality components in a nicely integrated unit.

Epson Endeavor WG

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

Based on an Intel 486SX/33 CPU, the Epson unit comes with a Quantum 244MB IDE hard disk with 256K of cache, a combination 1.2MB and 1.44MB floppy disk drive, motherboard-integrated Chips & Technologies Wingine video circuitry, and an Epson Model 800 14-inch monitor, limited to 800-by-600 resolution at 72 Hz.

The Epson is hampered by a relatively slow single-speed Sony CD-ROM drive, but the installed Media Vision Pro AudioSpectrum 16 card performed well on every measure, enabling the system to earn a good sound rating. The test system came with a pair of fair-quality Labtec CS-550 speakers (which cost an additional $40). A small selection of educational, entertainment, and reference CD-ROM software is included.

If you need drive expansion, you'll probably want to consider a larger-capacity system, since the Epson's three drive bays are already full. While RAM is expandable to 128MB, there is no external RAM cache, and the system con-

FACT FILE

Epson Endeavor WG

Epson Direct, 20770 Madrona Ave., Torrance, CA 90509; 800-374-7300; fax, 310-782-4455

List price (tested configuration): $2,529

Memory and processor RAM cache: 8MB 70-ns SIMMs

Disk drives and controller: Quantum LPS-240AT 16-ms 244MB IDE hard disk with 256K cache, integrated disk controller, and dual 1.2MB/1.44MB floppy disk drive.

Display: Integrated local-bus video controller with 1MB video RAM, Epson Extended VGA 14-inch monitor with a 72-Hz refresh rate at 800-by-600

Software: DOS 6.0; Microsoft Windows 3.1; Battle Chess Enhanced, CD-ROM version; Compton's Multi-Media Encyclopedia; Civilization; Mantis; Where in the World is Carmen Sandiego?, Deluxe Version

In short: The low-profile Epson Endeavor WG is a good entry-level system that provides average PC performance and good sound for $2,529. On the downside, it has a relatively slow processor, a rather limited monitor, and a slow, single-speed CD-ROM drive.

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tains only four 16-bit ISA slots.

The Epson turned in low-to-average DOSmark, Graphics Winmark, and Windows Applications scores. These were somewhat compensated for by the Epson's average Disk Winmark showing.

The standard one-year parts-and-labor-warranty comes with on-site service included at no extra charge.

The Epson Endeavor WG is a nicely integrated multimedia system with a slow CD-ROM drive but better-than-average sound-board performance. Although it has good support from a major vendor, the Epson machine is only an average buy because of its slow CPU and limited monitor.—*BB*

FutureTech Systems Inc.

FutureTech System 452eV

The $2,729 FutureTech System 452eV is a high-performance EISA local-bus multimedia system that has unexpectedly good expansion room and better-than-average performance. Unfortunately, the system is marred by poor sound quality.

FutureTech Systems packs an Intel 486DX2/50 CPU and 256K of RAM cache into the unit's tower case. The combined EISA and VESA local-bus system comes with a Western Digital 245MB IDE hard disk, a disk controller with 1MB of cache, a Diamond Viper VLB video card with 2MB of video RAM, and a 15-inch AOC International monitor, which displays 1,024-by-768 resolution at 72 Hz. Multimedia components include a Media Vision Pro AudioSpectrum 16 sound card, a Texel double-speed CD-ROM drive, inexpensive Labtec CD-180 utility speakers, and an assortment of educational, entertainment, and reference software.

FutureTech System 452eV

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	EXCELLENT
Multimedia	POOR

The Texel CD-ROM drive's typical double-speed throughput is desirable, but the Media Vision sound card produced significant clipping, which put this machine in our roundup's sound-quality cellar.

FACT FILE

FutureTech System 452eV

FutureTech Systems Inc., Six Bridge St., Hackensack, NJ 07601; 800-275-4414, 201-488-4414; fax, 201-488-4405

List price (tested configuration): $2,729.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Western Digital Caviar 2250 12-ms 245MB IDE hard disk with 64K cache, Tekram DC-680 disk controller with 1MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond Viper VLB video controller with 2MB video RAM, AOC CM-536 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, The Animals!, ChessMaster 3000, Compton's MultiMedia Encyclopedia, Mavis Beacon Teaches Typing, U.S. Atlas, World Atlas

In short: Although the FutureTech System 452eV offers fairly good CD-ROM throughput and adequate room for expansion, poor sound reproduction makes it hard to recommend

464 ON READER SERVICE CARD

The FutureTech case has lots of expansion room, with four accessible and three internal drive bays, and two 16-bit ISA, four 32-bit EISA, and two VL-Bus slots. RAM is expandable to 128MB on the motherboard. The system turned in high DOSmark and Graphics Winmark scores and average Disk Winmark and Windows Applications scores.

The FutureTech comes with a 15-month parts-and-labor warranty, with optional on-site service available for $79.

With a sound board that controls distortion better, the FutureTech would be a good buy. As configured, the system has good expansion room but is limited because of its poor sound quality.—*BB*

Gateway 2000

Gateway 2000 4DX2-66V

The $2,749 Gateway 2000 4DX2-66V comes with a standard CD-ROM drive, to which you need only add a sound board and speakers. Unfortunately, the multimedia components aren't competitive with those found in other systems on the market.

Based on an Intel 66-MHz 486DX2 CPU with 256K of RAM cache, the Gateway comes with a Western Digital 340MB IDE hard disk, an ATI XLR Ultra Pro local-bus video accelerator board, and a 14-inch MAG InnoVision monitor that can display 1,024-by-768 resolution at a 70-Hz refresh rate. The multimedia components consist of a single-speed Laser Magnetic Storage International CM-205 CD-ROM drive, Microsoft Windows Sound System (complete with a small external microphone), Microsoft Multimedia Pack for Windows CD-ROM software, and a set of $25 Labtec CS-180 speakers.

Gateway 2000 4DX2-66V

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR
Multimedia	POOR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

The Microsoft audio card produced clipping and high distortion, even at low power levels. Paired with a slow-throughput CD-ROM drive, it helped secure an unacceptable sound rating.

The Gateway system showed adequate test performance, posting an above-average DOSmark score and average Graphics Winmark and Disk Winmark results. It turned in below-average Windows Applications marks, however.

The system's desktop case has good expansion room, with five accessible drive bays, five ISA 16-bit slots, and two VESA local-bus slots. Motherboard RAM is expandable to 64MB.

Sold only through direct sales, the Gateway comes with a one-year parts-

SO ADVANCED IT EVEN TURNS ITSELF OFF.

PC MAGAZINE EDITORS' CHOICE
March 16, 1993
FlexScan F 940iW

1993 W 100 WINDOWS MAGAZINE ANNUAL WIN AWARD
FlexScan F 550i

Nanao, the technical leader in monitors has done it again. In addition to being the top choice of today's CAD/CAM, DTP and Windows users, Nanao's award-winning FlexScan monitors now have a remarkable energy-saving system — PowerManager.

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PC MAGAZINE MVP 92 WINNER
FlexScan T660i

PC MAGAZINE EDITORS' CHOICE
September 14, 1993
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CIRCLE 283 ON READER SERVICE CARD

FACT FILE

Gateway 2000 4DX2-66V

Gateway 2000, 610 Gateway Drive, N. Sioux City, SD 57049; 800-846-2000, 605-232-2000; fax, 605-232-2023

List price (tested configuration): $2,749.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Western Digital Caviar 2340 13-ms 340MB IDE hard disk with 128K cache, integrated disk controller with 128K cache, 1.2MB and 1.44MB floppy disk drives.

Display: ATI XLR Ultra Pro VESA local-bus card video controller with 1MB VRAM, MAG CrystalScan 1572 FS 14-inch monitor with 76-Hz refresh at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1. Choice of Borland Paradox, Microsoft Excel, Microsoft PowerPoint, Microsoft Project, Microsoft Word and Bookshelf '92, CD-ROM Edition

In short: The Gateway 2000 4DX2-66V is a fine PC, but it isn't much of a bargain because of its poor CD-ROM throughput and sound-card performance.

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and-labor warranty, with a contract for a year's free on-site service.

In sum, the Gateway performs better as a regular computer than a multimedia machine. The multimedia components just don't measure up.—*BB*

HiQ Systems Inc.

HiQ Multimedia Multimagic System

The HiQ Multimedia Multimagic System is an uneven performer. It comes in a full-size tower case and is capable of fast CD-ROM throughput, but the sound system is poor. Available for $2,725, this average system doesn't stand out.

The system comes equipped with a 33-MHz Intel 486DX CPU, 256K of cache, a 250MB Western Digital hard disk, an ATI Graphics Ultra local-bus-accelerated video card, and a 14-inch ADI monitor that runs at 70 Hz at 1,024-by-768 resolution. On the sound side, the HiQ uses a Media Vision Pro Audio-Studio 16 sound card and a fast-access, high-throughput Toshiba double-speed CD-ROM drive.

Reference and educational CD-ROM software packages are bundled with the system. Titles include Compton's MultiMedia Encyclopedia and Microsoft Bookshelf. There are no entertainment packages included. The system that we saw also came with inexpensive MLI CP-668 speakers, which cost an additional $15.

HiQ Multimedia Multimagic System

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	EXCELLENT
Multimedia	POOR

FACT FILE

HiQ Multimedia Multimagic System

HiQ Systems Inc., 740 N. Mary Ave., Sunnyvale, CA 94086; 800-827-5836, 408-245-5836; fax, 408-245-3108

List price (tested configuration): $2,725.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Western Digital Caviar 2250 13-ms 250MB IDE hard disk with 64K cache, integrated disk controller, 1.2MB and 1.44MB floppy disk drives

Display: ATI Graphics Ultra VESA local-bus card video controller with 1MB video RAM, ADI MicroScan 3E+ 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, The Animals!, Compton's MultiMedia Encyclopedia, Microsoft Bookshelf, Where in the World is Carmen Sandiego?

In short: The HiQ Multimedia Multimagic System has very fast CD-ROM throughput, but its sound performance was unacceptable

465 ON READER SERVICE CARD

The Toshiba CD-ROM drive had consistently high data throughput scores, greater than those turned in by most other double-speed drives. Unfortunately, the Pro Audio sound card had high distortion and clipping, knocking the HiQ out of serious multimedia consideration. The sound board's low signal-to-noise ratio and frequency response were also relatively unimpressive. Sound quality was rated unacceptable.

The HiQ's showing on our DOSmark, Graphics Winmark, Disk Winmark, and Windows Applications tests showed it to be solid but unexceptional.

The tower case has seven drive bays—four accessible and three internal. The motherboard can accommodate 64MB of system memory. There are six 16-bit ISA slots and two VESA local-bus slots.

Sold only via direct sales, the HiQ Multimedia Multimagic System comes with a one-year parts and two-year labor warranty. On-site service is included for the first year.—*BB*

Hi-Tech USA

Hi-Tech 486DX2-66 EISA/VLB MPC

The $2,745 Hi-Tech 486DX2-66 EISA/VLB MPC is a combination EISA/VL-Bus multimedia system that has good expansion room for a mini-tower-based machine. But its test results were mixed, and multimedia performance was poor.

Hi-Tech 486DX2-66 EISA/VLB MPC

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	GOOD
Multimedia	POOR

The Intel 66-MHz 486DX2 CPU-based Hi-Tech comes with 128K of RAM cache, a 211MB Maxtor hard disk, and a very high-performing VESA local-bus Diamond Viper video accelerator card with 2MB of video RAM. It also comes with a 14-inch CTX International monitor. Multimedia sound is

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Fire up your favorite game and get ready to be blown away. Because now every sound you couldn't hear with those other boards is going to come storming out of your PC with intensity like you've never heard before. Introducing Orchid's signal processing SoundWave 32.

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CIRCLE 350 ON READER SERVICE CARD

A built-in spreadsheet that's compatible with Lotus® 1-2-3,® includes sophisticated financial and statistical functions, 3-D graphs and print preview.

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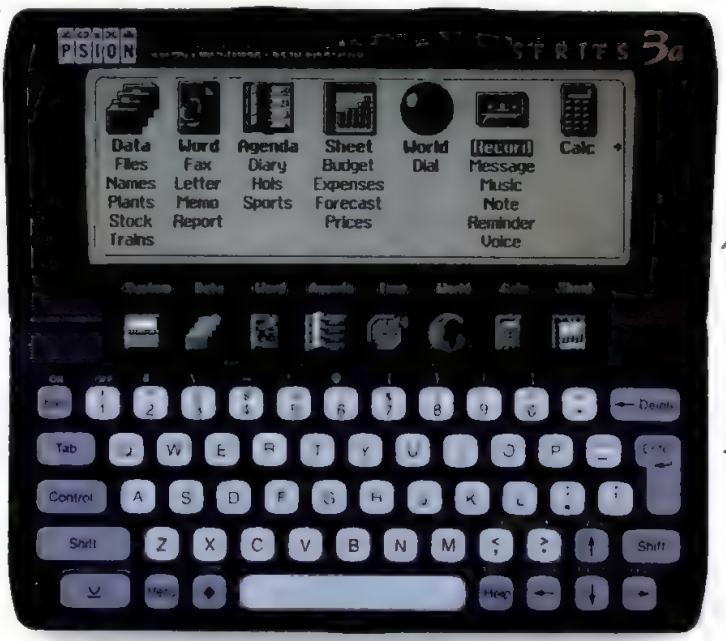

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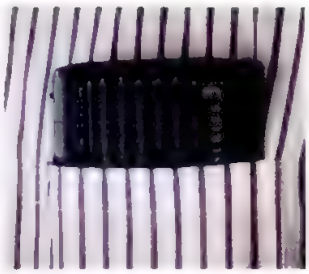

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CIRCLE 166 ON READER SERVICE CARD

FACT FILE

Hi-Tech 486DX2-66 EISA/VLB MPC

Hi-Tech USA, 1562 Centre Pointe Dr., Milpitas, CA 95035; 800-831-2888, 408-262-8688; fax, 408-262-8772

List price (tested configuration): $2,745.
Memory and processor RAM cache: 8MB 60-ns SIMMs, 256K external cache
Disk drives and controller: Maxtor 7213SR 15-ms 211MB SCSI hard disk with 64K cache, UltraStor Ultra 34F VESA local-bus hard disk controller card, 1.2MB and 1.44MB floppy disk drives
Display: Diamond Viper VLB VESA local-bus card with 2MB video RAM, CTX CVP5486NI 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768
Software: DOS 5.0, Microsoft Windows 3.1, Multimedia Encyclopedia 1.0.
In short: This unit has relatively slow CD-ROM throughput and uneven audio performance, which keeps it from earning a good recommendation.
467 ON READER SERVICE CARD

driven by a Creative Labs Sound Blaster 16 ASP board, and the CD-ROM drive is a Texel DM-3024. The Hi-Tech's CD-ROM software is limited to Multimedia Encyclopedia. Speakers are by way of ATI Technologies and are typical of what you might expect to get for the $10 they cost.

The Sound Blaster board had a high THD score and showed clipping, which is too bad, since it had good signal-to-noise ratio and frequency response. The Texel double-speed CD-ROM drive's throughput performance was slower in the Hi-Tech than it was in other units. Sound quality was unacceptable.

The Hi-Tech turned in uneven test results. DOSmark and Disk Winmark scores were below average, and the unit turned in the slowest Windows Applications test score here. Its Graphics WinMark score, however, was above average.

The mini-tower case has three accessible and two internal drive bays and five 16-bit ISA slots, one 32-bit EISA slot, and two VESA local-bus slots (which also can serve as EISA slots). RAM is expandable to 128MB.

The Hi-Tech comes with a one-year parts, two-year labor warranty but no on-site service.

In sum, the unit comes up short because of its problematic sound board and marginal performance.—*BB*

IBM Personal Computer Co.

IBM Multimedia for ValuePoint (MVP Series)

IBM's entry into the world of multimedia comes with an awkward name: the IBM Multimedia for ValuePoint (MVP Series). Listing for $2,743, the MVP falls short on sound performance but is otherwise an acceptable if low-powered PC system. IBM sells multimedia systems bundled with entertainment, business, or reference applications.

Based on an IBM 25-MHz 486SX CPU—one of the slowest CPUs here—the MVP comes with a 245MB Maxtor hard disk, S3-chip-based accelerated video circuitry, and a 14-inch IBM monitor running at 72 Hz at 1,024-by-768 resolution. The multimedia components we saw included a Creative Labs Sound Blaster 16, Sound Blaster CT-38 self-amplified speakers (included in the system price), a double-speed Matsushita CD-ROM drive, and reference and productivity CD-ROM software.

IBM Multimedia for ValuePoint

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	POOR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	AVERAGE

The Matsushita CD-ROM drive performed well, but the Sound Blaster had a relatively low high-frequency threshold, which contributed to a poor sound-quality rating. If sound quality is key to your application, you should specify a different sound card.

FACT FILE

IBM Multimedia for ValuePoint (MVP Series)

IBM Personal Computer Co., Rte. 100, Somers, NY 10589; 800-772-2227; fax, 800-426-4329

List price (tested configuration): $2,743.
Memory and processor RAM cache: 8MB 70-ns SIMMs
Disk drives and controller: Maxtor 7245A 15-ms 245MB IDE hard disk with 64K cache, integrated disk controller, 1.44MB floppy disk drive
Display: Motherboard video controller with 1MB DRAM, IBM PS/ValuePoint 6314 Color Display 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768
Software: IBM DOS 5.02, Microsoft Windows 3.1, HSC Interactive Special Addition, Kodak Photo CD Access Software and Sampler, Microsoft Bookshelf, Microsoft Works for Windows, Monologue for Windows, Multimedia Encyclopedia 1.0.
In short: With good CD-ROM throughput but relatively poor sound performance, this system is a mixed bag
468 ON READER SERVICE CARD

The MVP showed mixed test performance, turning in a very low DOSmark score and below-average Graphics Winmark and Disk Winmark scores. It managed above-average Windows Applications scores, however.

The MVP's small-footprint desktop ISA-bus machine has three accessible drive bays, one internal bay, four 16-bit slots, and one VL-Bus slot. RAM is expandable to 64MB.

A one-year parts-and-labor warranty comes with on-site service coverage.

The MVP is hampered by poor sound, and its price is high compared with the cost of systems with faster CPUs.—*BB*

Image Microsystems

Image M-line 486DX2-66VL

Image Microsystems' $2,690 Image M-line 486DX2-66VL is a multimedia system with poorly matched components that lead to uneven performance. A fast, high-throughput CD-ROM drive is unfortunately paired with a flawed audio board that distorts sound unacceptably.

Image M-Line 486DX2-66VL

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	GOOD
Multimedia	POOR

Based on an Intel 66-MHz 486DX2 CPU, the Image comes with a 255MB Western Digital hard disk, a Diamond Stealth 24VL S3-based local-bus video accelerator card, and a 14-inch ViewSonic 6E monitor with a 60-Hz refresh rate at 1,024-by-768. The minitower case has five accessible drive bays, one 8-bit slot, three 16-bit slots, and three VL-Bus slots.

A Media Vision Pro AudioStudio 16 sound card, a Toshiba XM-3401B CD-ROM drive, very low-quality JS-008 speakers, and a selection of CD-ROM reference and productivity software complete the package. The Toshiba double-speed CD-ROM drive provided fast access and high throughput, but the Media Vision card produced clipping, high distortion levels, and a low signal-to-noise ratio. The combination added up to an unacceptable sound-quality rating.

On our tests, the Image showed better-than-average performance. Processor, DOSmark, and Windows Applications scores were either in the top ten or just below; DOS- and Windows-based video marks were below average.

The unit comes with a one-year parts and lifetime labor warranty. Unfortunately, on-site service is not available, even as an option. If you can't determine the cause and solution to problems via the 24-hour toll-free technical support line, you'll have to pay to ship the system back to the company's California facility.

Its sound quality notwithstanding, the Image is a relatively high-performance system, with high CD-ROM throughput and slightly better-than-average performance.—*BB*

FACT FILE

Image M-Line 486DX2-66VL

Image Microsystems, 10700 Santa Monica Blvd., #4312, Los Angeles, CA 90025; 800-729-3400, 310-815-1000; fax, 310-815-9100

List price (tested configuration): $2,690.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Western Digital Caviar 2200 13-ms 250MB IDE hard disk with 64K cache, UMC disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Diamond Computers Systems Stealth 24VL VESA local-bus card video controller with 1MB DRAM, ViewSonic 6E 7034T 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, HALO Desktop Imager, Mammals: A Multimedia Encyclopedia, Midisoft, Monologue for Windows, Sound Impressions for Windows, Spinnaker PFS Windows Works, and other titles

In short: The unit's poor sound performance is offset by its fast CD-ROM throughput and better-than-average system performance.

468 ON READER SERVICE CARD

Insight

Insight 486DX2-66 VL-Bus Multimedia

The Insight 486DX2-66 VL-Bus Multimedia is a complete multimedia package that sells for $2,749 without speakers or $2,868 with the Altec Lansing ATS-100 amplified speakers included with our test unit. In general, the unit is competitive, but sound-production capability is weak.

The full-tower case has an Intel 66-MHz 486DX2 CPU, 256K of RAM cache, a Western Digital 340MB IDE hard disk, an STB Horizon video accelerator video card, and a 15-inch CTX monitor with a 72-Hz refresh rate at 1,024-by-768.

Insight 486DX2-66 VL-Bus Multimedia

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	GOOD
Multimedia	POOR

Multimedia components include a Media Vision Pro AudioSpectrum 16 sound card, a Talon CD-ROM disk drive, and a selection of CD-ROM software.

The double-speed Texel CD-ROM drive performed well, but the Media Vision sound card did not. Sound produc-

FACT FILE

Insight 486DX2-66 VL-Bus Multimedia

Insight, 1912 W. 4th St., Tempe, AZ 85281; 800-927-7848, 602-902-1176; fax, 602-350-1150

List price (tested configuration): $2,749.

Memory and processor RAM cache: 8MB 60-ns SIMMs, 256K external cache.

Disk drives and controller: Western Digital 2340A 12-ms 340MB IDE hard disk with 64K cache, Insight VESA local-bus hard disk controller card, 1.2MB and 1.44MB floppy disk drives.

Display: STB Horizon-VL VESA local-bus card video controller with 1MB dynamic RAM, CTX CMS-1561 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, The Animals!, Guinness Book of Records, Lotus 1-2-3 with SmartHelp, Mayo Clinic Family Health Book, National Parks Guide, and other titles.

In short: A relatively poor sound performance takes away from this generally good system

370 ON READER SERVICE CARD

tion suffered from clipping and high distortion levels, although the unit had fine high- and low-frequency response. Sound quality, however, was deemed unacceptable.

The Insight case has ample expansion room, with six accessible and two internal drive bays. There are five 16-bit ISA and two VL-Bus slots, and RAM is expandable to 32MB.

The unit turned in mixed test results, posting an above-average DOSmark score, a very high Disk Winmark result, and low Windows Applications and Graphics Winmark scores.

The company sells systems and components via the direct channel and offers a one-year parts-and-labor warranty. No on-site service contract is available. Technical support is available 24 hours a day, but if problems are unresolved, you have to pay to ship the system to Insight's Arizona facility.

The Insight system is an average computer with standard components, a bit above-average performance, and below-average sound quality.—*BB*

International Instrumentation Inc.

Blue Max Multimedia Monolith

If you're looking for a high-quality multimedia system without compromises, International Instrumentation's Blue Max Multimedia Monolith combines VESA local-bus video with quality sound and good performance for $2,699.

With an Intel 33-MHz 486DX CPU, the Blue Max has 256K of external RAM cache, a 251MB Conner hard disk, a Genoa 8500VL local-bus video-accelerator card, and a 14-inch Samsung monitor with a 60-Hz refresh rate at 1,024-by-768.

In addition to a Creative Labs Sound Blaster 16 ASP card, the Blue Max comes with a Toshiba CD-ROM drive and three pieces of CD-ROM software (Nautilus, Microsoft Multimedia Beethoven: The Ninth Symphony, and Multimedia Encyclopedia). The test system was supplied with high-quality Acoustic Research speakers that are not included in the price.

Blue Max Multimedia Monolith

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	GOOD
Multimedia	GOOD

PC MAGAZINE EDITORS' CHOICE

FACT FILE

Blue Max Multimedia Monolith

International Instrumentation Inc., 2282 Townsgate Rd., Westlake Village, CA 91361; 800-543-3475, 805-495-7673; fax, 805-379-0701

List price (tested configuration): $2,699

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Conner CP30254 14-ms 251MB IDE hard disk with 64K cache, Promise DC-4030VL-1 VESA local-bus hard disk controller card with 4MB cache, 1.2MB and 1.44MB floppy disk drives

Display: Genoa WindowsVGA 24 8500VL VESA local-bus card video controller with 1MB DRAM, Samsung CSJ4927A 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, Multimedia Beethoven: The Ninth Symphony, and other titles

In short: The Blue Max Multimedia Monolith's fast CD-ROM drive and good sound performance make this value-loaded system easy to recommend

471 ON READER SERVICE CARD

The Toshiba CD-ROM drive's throughput was about 10 percent better than that of most double-speed drives—a bonus that can pay off when accessing large files. The Sound Blaster card also performed very well in this system, with low distortion, high signal-to-noise ratio, and the best tested frequency response here. Sound quality was good—among the best in this roundup.

PC performance was not as stellar as the unit's audio results, but it was impressive nonetheless. The Blue Max earned high DOSmark and average Graphics Winmark scores and landed in the top quarter on our Windows Applications tests. Disk scores particularly stood out; the unit ranked first on our DOS and Windows disk tests.

The Blue Max's mini-tower case has four accessible drive bays and one internal bay. Motherboard RAM is expandable to 32MB, and there are five 16-bit ISA and three VL-Bus slots. The system, which is sold directly and through dealers, is covered by a one-year parts-and-labor warranty, with free on-site service.

International Instrumentation has a winner with the Blue Max.—*BB*

Mega Computer Systems

Mega R486/33-MPC

The $2,313 Mega R486/33-MPC is relatively inexpensive, but it disappoints with its unacceptable sound quality and relatively slow CD-ROM throughput.

The Mega uses Intel Corp.'s EPA Energy Star–compliant power-conservation chips, along with an Intel 33-MHz 486DX CPU. Included in the system price are 128K of external RAM cache, a 210MB Conner hard disk, a Cirrus Logic–based proprietary local-bus video-accelerator card, and a 14-inch MGC monitor with a 72-Hz refresh rate at 1,024-by-768.

Mega R486/33-MPC

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	POOR

The multimedia components are also standard: They include an Aztech Sound Galaxy NX Pro 16 sound card, a Panasonic CD-ROM drive, fair-quality MLi CP-668 speakers, and educational and entertainment CD-ROM software.

The CD-ROM drive supplied is only a single-speed drive, but Mega Computer Systems also offers dual-speed CD-ROM drives from Texel and NEC Technologies. The Sound Galaxy sound card produced high distortion, a low signal-to-noise ratio, and very poor frequency response, making the Mega unsuitable for most sound applications.

The Mega turned in average marks on our DOSmark, Disk Winmark, and Windows Applications tests. The proprietary local-bus video card was a disappointing

performer, posting the lowest Graphics Winmark score of all systems we saw in this roundup.

The Mega comes in a slimline case with four drive bays and three 16-bit ISA slots. RAM cache is expandable to 256K, and the system memory can be increased to 32MB.

A one-year parts-and-labor warranty comes with the system, but on-site service costs $365 a year.

Unfortunately, price alone can't save the Mega. Unacceptable sound quality and slow CD-ROM throughput make it a poor choice for multimedia applications. And if price *is* your most important criteria, look elsewhere; other reviewed systems offer significantly better performance for less money.—*BB*

FACT FILE

Mega R486/33-MPC

Mega Computer Systems, 10840 Thornmint Rd., San Diego, CA 92127; 800-338-6628, 619-487-8888; fax, 619-485-1518

List price (tested configuration): $2,313.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache

Disk drives and controller: Conner CP30204 12-ms 210MB IDE hard disk with 256K cache, SMC FDC37C651 motherboard disk controller, 1.2MB and 1.44MB floppy disk drives

Display: Integrated video controller with 1MB dynamic RAM, MGC 1402N 14-inch monitor with a 50-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, ChessMaster 3000, Mavis Beacon Teaches Typing, Software Toolworks Atlas Pack

In short: The Mega R486/33-MPC sells for only $2,313, but its unacceptable sound quality, poor-performing sound board, and slow CD-ROM drive detract from its allure. If price is an important factor, other reviewed units offer considerably better performance at comparable prices

472 ON READER SERVICE CARD

Micro Express

MicroFLEX-VL/Multimedia

The $2,550 MicroFLEX-VL/Multimedia is an average multimedia system with no stand-out features to speak of other than the company's service policies.

MicroFLEX-VL/Multimedia

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	GOOD
Multimedia	POOR

Our test unit came with an Intel 486DX2/66 CPU, 256K of secondary RAM cache, a 212MB Western Digital hard disk, a Promise Technology IDE drive controller with 512K of cache, an ATI Graphics Ultra local-bus accelerated video card, and a 14-inch Micro Express monitor with a 72-Hz refresh rate at 800-by-600. Completing the multimedia package were a Creative Labs Sound Blaster 16 ASP audio card, an NEC MultiSpin 84 CD-ROM drive, and inexpensive Labtec CS-150 speakers. The MicroFLEX also came with Software Toolworks Atlas Pack.

The double-speed NEC CD-ROM drive served the MicroFLEX well, but the Sound Blaster card did not perform well, with drop-off at low and high frequencies and a low signal-to-noise ratio. The system achieved a poor sound rating.

The MicroFLEX earned mixed PC test scores, posting very high DOSmark, above-average Disk Winmark, and average Graphics Winmark results.

The MicroFLEX mini-tower case has five accessible drive bays, one internal bay, one 8-bit ISA slot, five 16-bit ISA slots, and two VL-Bus slots. It comes with 256K of RAM cache, and RAM can be expanded to 32MB.

The MicroFLEX package comes with a two-year parts-and-labor warranty, with on-site service available via GE at a cost of $50 for one year. If you don't opt for the on-site contract and you can't fix a problem via the 24-hour toll-free technical-support line, you can send it to the company's California facility for repair. Micro Express will pay for shipping both ways for the first four months that you own the computer.

FACT FILE

MicroFLEX-VL/Multimedia

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-989-9900, 714-852-1400; fax, 714-852-1225

List price (tested configuration): $2,550

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Western Digital Caviar 2200 14-ms 212MB IDE hard disk with 128K cache, Promise DC4030VL VESA local-bus hard disk controller card with 512K cache; 1.2MB and 1.44MB floppy disk drives

Display: ATI Graphics Ultra VESA local-bus card video controller with 1MB video RAM, Micro Express FM360 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, Software Toolworks Atlas Pack

In short: The $2,550 MicroFLEX-VL/Multimedia has speedy CD-ROM throughput, a good service-and-support policy, and better-than-average performance, but it provides less-than-satisfactory sound performance

473 ON READER SERVICE CARD

This reassuring, comprehensive service policy is the unit's best feature. Otherwise, it's just an average system.—*BB*

Micro Generation

Micro Generation 486 VL-Bus Multimedia System

The $2,695 Micro Generation 486 VL-Bus Multimedia System is an average desktop PC that grafts on acceptable multimedia components.

Based on an Intel 33-MHz 486DX CPU, the Micro Generation we tested had 256K of RAM cache, a 250MB West-

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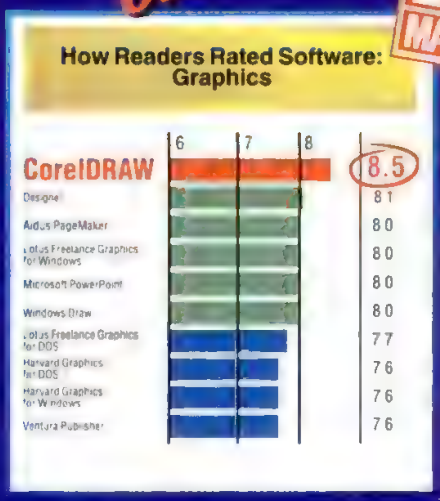

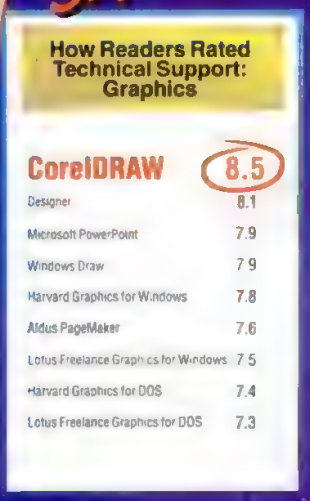

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ern Digital hard disk with a WinBond local-bus drive controller, an ATI Mach 32 chip–based video accelerator, and a 15-inch MAG InnoVision monitor with a 60-Hz refresh rate at 1,280-by-1,024.

The multimedia peripherals consisted of Thunder Media's Thunder Audio Spectrum 16 sound card, fair Multimedia CD Laser Station speakers, a slow Mitsumi CD-ROM drive, and entertainment and reference CD-ROM software.

The slow single-speed Mitsumi CD-ROM drive is the only drive offered with this system. The Thunder Media sound card kept distortion low but could only produce an extremely low signal-to-noise ratio. These components worked together to produce fair but unimpressive sound quality.

Micro Generation 486 VL-Bus Multimedia System

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	GOOD
Multimedia	FAIR

The desktop computer itself was just an average performer, with middle-of-the-field scores on our DOSmark, Graphics Winmark, Disk Winmark, and Windows Applications tests.

The case has four accessible drive bays, one internal bay, five 16-bit ISA slots, and two VL-Bus slots. RAM is expandable to 128MB, and external processor cache can use up to 1MB.

Available through dealers and directly from Micro Generation, the unit has a one-year parts and lifetime labor warranty, with on-site service available via TRW for $65 a year. Toll-free technical support is available during weekday business hours.

Unfortunately, there's little about this system to recommend. For a similar price, you can find better components and hotter performance from several of the other systems we look at in this roundup.—*BB*

FACT FILE

Micro Generation 486 VL-Bus Multimedia System

Micro Generation, 300 McGaw Dr., Edison, NJ 08837; 800-872-2841, 908-225-8899; fax, 908-225-8999

List price (tested configuration): $2,695

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Western Digital WD-AC2250 13-ms 250MB IDE hard disk with 64K cache, WinBond VL-Bus disk controller, 1.2MB and 1.44MB floppy disk drives

Display: ATI Mach 32 video controller with 2MB video RAM, MAG 1564 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024

Software: DOS 6.0, Microsoft Windows 3.1, MCS Stereo, Microsoft Bookshelf, Sequencer Plus Junior, Sherlock Holmes: Consulting Detective

In short: The Micro Generation 486 VL-Bus Multimedia System is a computer with average performance and fair sound quality

474 ON READER SERVICE CARD

Micron Computer Inc.

Micron 466VL Magnum MPC

At $2,748, the Micron 466VL Magnum MPC boasts some strong components but is hampered by poor sound.

Micron 486VL Magnum MPC

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	GOOD
Multimedia	POOR

Starting with an Intel 66MHz 486DX2 CPU and 256K RAM cache, the test unit had a 245MB Maxtor hard disk, integrated 32-bit local bus drive interface, 1.2/1.44MB combination floppy disk drive, 1MB Diamond Viper VLB local-bus accelerated video card, and 76-MHz 1,280-by-1,024 15-inch Mag monitor. Multimedia functions are performed by a Creative Labs Sound Blaster 16 ASP sound card and Chinon CD-ROM drive. High-quality Altec Lansing ACS-300 speakers with subwoofer came with the system but weren't reflected in the price. The MPC comes with a selection of entertainment, reference, and educational software.

The Chinon CD-ROM drive is of the double-speed variety with good access time and data-throughput rates. But the Sound Blaster 16 ASP, although achieving a good signal-to-noise ratio, had high sound distortion and somewhat limited frequency response, making for poor sound quality.

Performance scores for this PC were generally strong, but not entirely. While DOSmark and Disk Winmark scores were average, the Graphics Winmark score was the highest, and the Windows Applications test suite and memory score were both sec-

FACT FILE

Micron 466VL Magnum MPC

Micron Computer Inc., 915 E. Karcher Rd., Nampa, ID 83687; 800-388-6334, 208-465-3434; fax, 208-465-3424

List price (tested configuration): $2,748.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Maxtor 7245AT 15-ms 245MB IDE hard disk with 64K cache, integrated disk controller, dual 1.2MB/1.44MB floppy disk drive.

Display: Diamond Viper VLB VESA local-bus card video controller with 1MB video RAM, MAG InnoVision LX1564 15-inch monitor with a 76-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, choice of WordPerfect for Windows 5.2, WordPerfect Presentations 2.0, Paradox for Windows, Quattro Pro for Windows

In short: With fast CD-ROM throughput but poor sound quality, the Micron 466VL Magnum MPC is not competitive for multimedia applications, even though it earned very fast graphics scores

475 ON READER SERVICE CARD

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CIRCLE 118 ON READER SERVICE CARD

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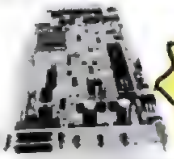

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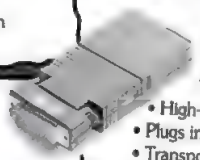

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ond highest. Unfortunately, the DOS video and disk scores were extremely low.

The system's desktop case has three accessible and two internal drive bays and seven 16-bit ISA and two VESA local bus slots. System RAM is expandable to 64MB.

Micron Computer sells directly and through dealers. All systems come with a one-year parts and labor warranty with on-site service included.

The MPC's good CD-ROM throughput and hot Graphics Winmark, Windows Applications, and memory scores are attractive, but poor sound mars the overall impression.—*BB*

Mitsuba Corp.

Mitsuba Multi-Pro 486DX/33

The $2,495 price tag for the Mitsuba Multi-Pro 486DX/33 is intriguing: the system's performance was mid-range compared to other PCs in the same CPU class; it included a slow Mitsuba CD-ROM drive and earned only a fair rating for its overall sound quality.

The Mitsuba was tested with an Intel 33MHz 486DX CPU, 251MB Conner hard disk, dual 1.2/1.44MB floppy disk drive, Tseng Labs chip-based local-bus accelerated video, and 14-inch 72-Hz 1,024-by-768 OEM monitor. A Thunder Media Thunder Audio Spectrum 16 sound card; a Mitsumi CD-ROM disk drive; inexpensive, low-quality MLi CP-55 speakers; and a selection of productivity, entertainment, and reference CD-ROM software come with the system (speakers not included in the price).

Mitsuba Multi-Pro 486DX/33

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	FAIR

The Mitsumi CD-ROM disk drive is a single-speed unit with low data-throughput rates (Mitsuba Corp. doesn't offer a CD-ROM upgrade). The Thunder Audio Spectrum 16 sound card was acceptable in terms of distortion levels but had a low signal-to-noise ratio and a higher than desirable low-frequency response cutoff level. On the upside, this unit did not produce clipping; but this was not enough to boost the system past a "fair" rating on sound quality.

FACT FILE

Mitsuba Multi-Pro 486DX/33

Mitsuba Corp., 1925 Wright Ave., LaVerne, CA 91750; 800-648-7822, 909-392-2000; fax, 909-392-2021

List price (tested configuration): $2,495

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Conner CP30254 14-ms 251MB IDE hard disk with 64K cache, BCM Advanced Research CVESA VESA local-bus hard disk controller card with 256K cache, dual 1.2MB/1.44MB floppy disk drive

Display: BCM Advanced Research CVESA VESA local-bus card video controller with 1MB dynamic RAM, Mitsuba m710VS 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, King's Quest V, Microsoft Bookshelf, Microsoft Works, Mixed-Up Mother Goose

In short: The Mitsuba Multi-Pro 486DX/33 is an average system hampered by slow CD-ROM throughput and only fair sound quality

476 ON READER SERVICE CARD

The Mitsuba's poor showing on our Windows-based video test—less than 8 megapixels per second—is balanced by its top-five DOS video score. On the remaining tests, the Mitsuba showed itself an average performer on the PC Labs' benchmark tests. The unit's small footprint desktop case has one internal and three accessible drive bays, five 16-bit ISA and two VESA local bus slots, and memory expansion. System memory is limited to 32MB.

Sold only by dealers, the Mitsuba comes with a two-year parts and labor warranty. First-year on-site service by Wang Labs costs $25.—*BB*

MS Engineering Inc.

MSE486DX2-66V

The MSE486DX2-66V is packed with high-performance components that make this $2,750 system a screamer. The one downside is low-quality sound. The MSE generally out-performed almost all systems we reviewed, seeming especially well-suited for the Windows environment.

The MSE is housed in a tower case with three 5.25-inch and two 3.5-inch accessible drive bays. The test unit had a CTX 14-inch monitor with 1,280-by-1,024 resolution.

MSE486DX2-66V

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	GOOD
Multimedia	POOR

At the core of the MSE's power is the Micronics VL-Bus system board that also performed well in the other two units that use it, the Gateway 2000 4DX2-66V and the Micron 466VL Magnum MPC. The system board had 256K of external processor RAM cache. On our memory test, the MSE stood apart from the pack (along with the other two Micronics-based systems) with a score of 9,642K per second. The hard disk was a Quantum 240S SCSI 240MB drive with 256K of cache memory on board. This was paired with a Buslogic SCSI adapter. The combination fared well on our disk tests, with a score that was nearly double the average. Also included was a Diamond Viper VL-Bus video board, which uses the Weitek P9000 chip set. The MSE achieved an impressive Graphics Winmark score of 49 megapixels per second—one of the highest in the roundup. Also, the high-performance disk and video subsystems combined for the best Windows Applications score.

The test system had a Texel double-speed CD-ROM drive, Media Vision Pro AudioSpectrum 16 sound board, and relatively low-quality Discwasher SM 250C speakers. Unfortunately, the sound board exhibited severe clipping, resulting in a poor sound quality rating.

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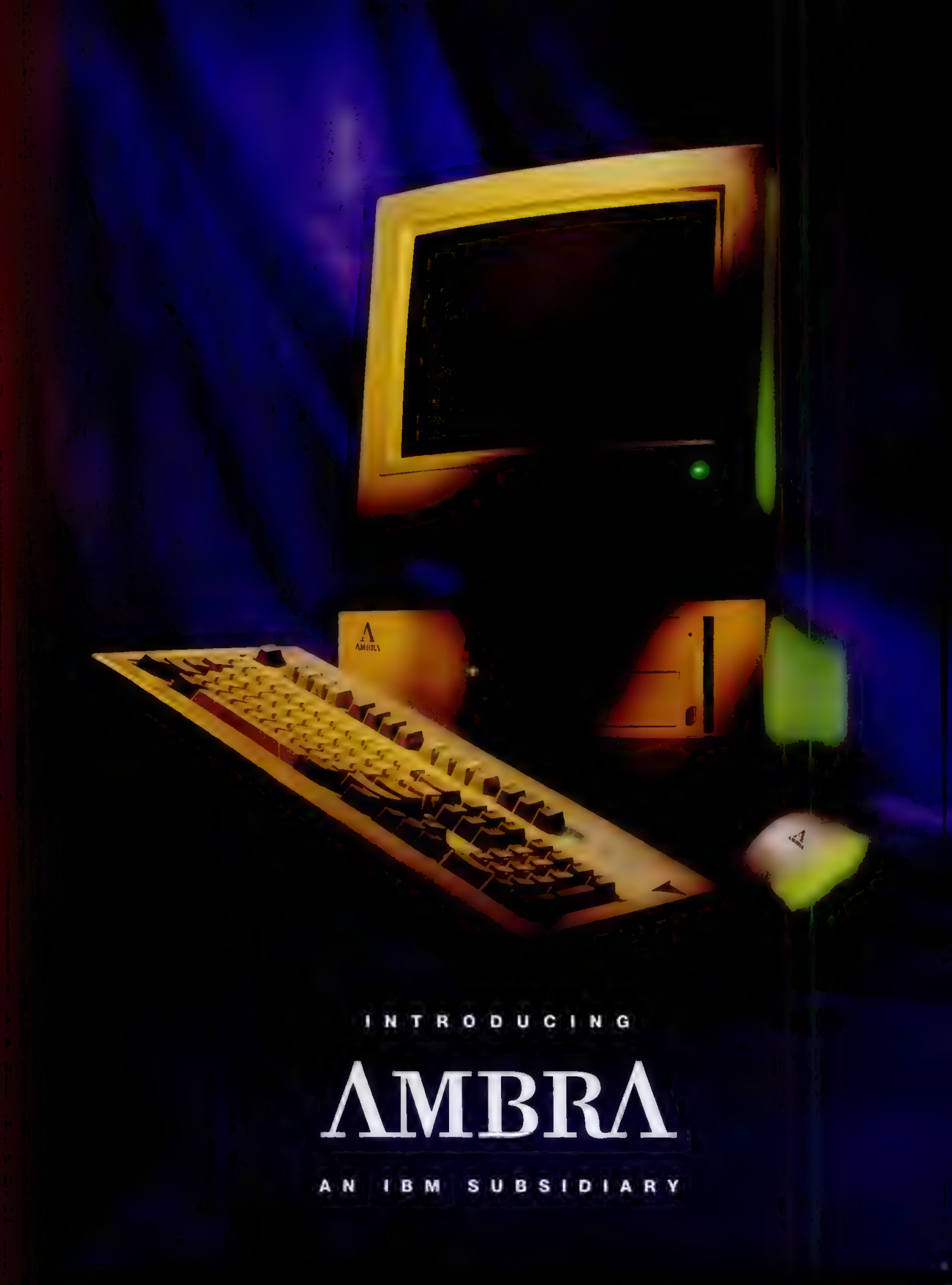
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FACT FILE

MSE486DX2-66V

MS Engineering Inc., 10601 S. De Anza Blvd., #214, Cupertino, CA 95014; 408-257-4249; fax, 408-257-4398

List price (tested configuration): $2,750.
Memory and processor RAM cache: 8MB 60-ns SIMMs, 256K external cache.
Disk drives and controller: Quantum ProDrive 240S 15-ms 240MB SCSI hard disk with 256K cache, Buslogic BT-445S VESA local-bus hard disk controller card with 64K cache, dual 1.2MB/1.44MB floppy disk drive.
Display: Diamond Viper VESA local-bus card video controller with 2MB video RAM, CTX CMS-1461 14-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 resolution.
Software: DOS 6.0, Microsoft Windows 3.1.
In short: Although one of the fastest systems reviewed for this roundup, the MSE486DX2-66V comes with no bundled multimedia software, and its sound card exhibited severe clipping problems during testing, which made its sound quality unacceptable. These problems make for a less than well-rounded multimedia system.
477 ON READER SERVICE CARD

Though it's a powerful VL-Bus machine, the MSE's poor sound and lack of bundled software make for a less than well-rounded multimedia system. —*Stephen W. Plain*

National MicroComputers

National MicroComputers Universal Pro-System

The $2,743 National MicroComputers Universal Pro-System provides a value choice with good performance, sound quality, and an impressive selection of bundled software.

The 486DX/33 NMC comes in a desktop case with three accessible half-height

Multimedia PCs

List price (tested configuration) Unless specified, all prices are list prices for machines as tested by PC Magazine Labs. Some vendors are avoiding list prices and are using estimated selling prices instead to reflect what a customer would pay.

Dealers/Direct-distribution channel Various machines are sold through dealers (or company-owned stores) or directly through mail order. For machines sold through dealers, *PC Magazine* views a 15 percent discount off the suggested retail price as typical.

The **chip set manufacturer** makes the logic that connects the CPU with the other functions managed by the system board.

The **processor upgrade path** indicates whether the PC has a standard, ZIF (zero-insertion-force), or LIF (low-insertion-force) socket. In some cases, a PC may have a slot for a separate processor card, which offers an easy means of upgrading the system, but none of the units in this roundup came with that feature.

The **BIOS version (or date)** can affect the system's performance on PC Magazine Labs' benchmark tests. A PC with another BIOS may perform differently.

Flash memory contains BIOS code that can be updated via software. The BIOS is generally stored in conventional ROM, which has no provision for modification.

Installable RAM on motherboard indicates the amount of memory that can be installed using any combination of chips and proprietary cards.

Cache architecture A *four-way set-associative* cache, native to the 486's internal 8K cache, divides data into four equal blocks; it is considered the most effective type of cache. A *two-way set associative* cache's data is split into two equal blocks, and the data in a *direct-mapped* cache (the most common and least costly type) is not divided.

Cache write design A *write-back* design can cache data read from and written to memory. This method is theoretically superior to that of a *posted write-through* cache, which buffers all writes until the system bus is free before completing them, and that of a *write-through* cache, in which only reads from memory are cached.

Accessible drive bays can be reached from the system's front panel and can support removable media; **internal drive bays** can be reached only by opening the case. We report the maximum number of accessible and internal drives the system can hold.

Floppy disk drives We report the types of floppy disk drives each tested system contains. A *dual* floppy disk drive combines a 1.2MB and a 1.44MB unit inside a single drive bay.

Hard disk options We report the range of hard disk capacities the vendor offers for each system.

Disk controller location The disk controller can reside on an ISA, EISA, or local-bus expansion card or on the PC's motherboard.

Expansion bus For each type of expansion slot—8-bit, 16-bit, and 32-bit (EISA, MCA, or proprietary)—we report the number of slots on the motherboard. We also report the number of VESA, PCI, and proprietary bus slots each unit offers, and indicate how many parallel, serial, and mouse ports are integrated onto the motherboard.

The **display circuitry** can reside on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled it is not upgradable. All the systems reviewed here use local-bus video—sometimes implemented via VL-Bus expansion cards, sometimes integrated onto the motherboard using either the VL-Bus standard ("motherboard VL-Bus" on the table) or a proprietary method ("motherboard LB").

DOS 6.0/Microsoft Windows 3.1 included We indicate whether or not these software packages come bundled with the base-priced system.

The **on-site service charge** may be included in the price of the system, or it may be a set or variable added cost. If the charge varies, it is often determined by the system's configuration and cost.

▶ SUMMARY OF FEATURES

Multimedia PCs

Products listed in alphabetical order

■ = YES □ = NO

	ACMA MPC/433	ACR MIA66	AnyBus 486/33ISM	Ares 486-33SX VLB MPC	ATronics ATI-486 Multi Media	Axik Ace Cache 486-33V/MPC
List price (tested configuration)	$1,895	$2,708	$2,699	$2,749	$2,748	$2,748
Processor type and speed	Intel 486SX/33	Intel 486DX2/66	Intel 486DX/33	Intel 486SX/33	Intel 486DX2/66	Intel 486DX/33
Hard disk capacity	210MB	240MB	340MB	250MB	205MB	234MB
Dealers/Direct-distribution channel	■■	■■	■□	□■	■■	□■
Case style	Desktop	Mini-tower	Slimline	Mini-tower	Tower	Tower
Bus architecture	ISA	ISA	ISA	ISA	ISA	ISA
Power supply (and number of connectors)	100W (5)	220W (7)	200W (5)	250W (3)	250W (5)	250W (7)
Motherboard and CPU						
Motherboard manufacturer	USA Integration	ACR	IBM	Micronics	ATronics	Axik
Chip set manufacturer	USA Integration	SIS	OPTi	C&T	USA Integration	SIS
Processor upgrade path	Standard socket	ZIF socket	ZIF socket	ZIF socket	Standard socket	ZIF socket
BIOS version (or date)	AUI (6/6/92)	AMI (11/11/92)	Microid V1.45	Phoenix 0.10 1.13 LB JMX30	AMI (11/11/92)	AMI (11/11/92)
Flash memory	□	□	□	□	□	□
Memory and Processor RAM Cache						
Installable RAM on motherboard	1MB–32MB	4MB–32MB	1MB–64MB	4MB–64MB	1MB–32MB	1MB–32MB
External RAM cache installed	128K	256K	256K	64K	256K	256K
Cache architecture	Direct-mapped	Direct-mapped	Two-way set-associative	Direct-mapped	Direct-mapped	Direct-mapped
Cache write design	Write-back	Write-through	Write-back	Write-through	Write-back	Write-back
Disk Drives						
Accessible drive bays (5.25", 3.5")	2, 1	2, 2	2, 2	4, 0	6, 0	4, 0
Internal drive bays (5.25", 3.5")	1, 0	0, 1	0, 0	5, 1	0, 3	1, 4
Floppy disk drives	Dual	1.2MB, 1.44MB	Dual	Dual	1.2MB, 1.44MB	Dual
CD-ROM drive manufacturer and model	Matsushita CR-523-B	Toshiba XM-3401B	Sony CDU31A-02	Mitsumi CRMC-LU005S	Matsushita CR521-B	Texel DM-3024
Hard disk options	256MB–2GB	120MB–1.2GB	340MB	170MB–1.2GB	80MB–1GB	116MB–2GB
Disk controller location	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card
Expansion Bus						
8-bit, 16-bit, 32-bit slots	1, 5, 0	0, 5, 0	0, 3, 0	0, 6, 0	1, 5, 0	0, 5, 0
VESA, PCI, proprietary bus slots	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
Sound card manufacturer and model	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16 ASP	Thunder Media Thunder Audio Spectrum 16	Media Vision Pro AudioSpectrum 16	Creative Labs Sound Blaster Pro	Media Vision Pro AudioSpectrum 16
Video						
Display circuitry location	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card
Video chip set manufacturer	S3	Weitek	Cirrus Logic	S3	Weitek	S3
Miscellaneous						
DOS 6.0/ Microsoft Windows 3.1 included	■■	■■	■■	■■	■■	■■
Warranty	1 year	1 year parts, 5 years labor	2 years	2 years parts, lifetime labor	1 year	1 year
On-site service charge	Included (1 year)	Varies	$14.95 (1 year)	Included (1 year)	$65 (1 year)	Included (1 year)

N/A—Not applicable. The product does not have this feature. ATI—ATI Technologies Inc., Asus—Asus Tek Computer Inc., C&T—Chips & Technologies Inc., DFI—DFI Inc., ECS—Elite Group Computer Systems Inc., EFA—EFA Corp. of Ame
IIT—Integrated Information Technologies. MCCI—Micro Center Computer Inc. SCI—SCI Systems Inc. SIS—Silicon Integrated Systems Corp. UMC—United Microelectronics Corp. VLSI—VLSI Technology Inc. WD—Western Digital Corp.

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lue Star 86DX/33 Series II 3/MM-Kit #7	C² Saber Sound	Clover PRO-VM486	CMO FLB433X	Comp & Soft CS 486/25SX256-VLB	Compaq ProLinea CDS	Compudyne 486DX/33 Multimedia System	Comtrade Multimedia (VL-Bus) 66	Dell 433s/L Family Station
$2,649	$2,335	$2,375	$2,499	$2,495	$2,379 (estimated selling price with speakers)	$2,599	$2,745	$2,699
el 486DX/33	IBM 486SLC2-50	Intel 486DX/33	Intel 486SX/33	Intel 486SX/25	Intel 486SX/25	Intel 486DX/33	Intel 486DX2/66	Intel 486SX/33
249MB	212MB	213MB	527MB	214MB	244MB	245MB	250MB	245MBM
■■	■■	■■	■■	■■	■■	■■	□■	■■
Mini-tower	Desktop	Tower	Desktop	Mini-tower	Slimline	Desktop	Desktop	Slimline
ISA	ISA	ISA	ISA	ISA	ISA	ISA	EISA	ISA
220W (5)	200W (4)	200W (5)	200W (5)	230W (4)	146W (5)	200W (4)	200W (4)	146W (5)
Tyan	Alaris	Contaq	Shuttle Data	EFA	Compaq	SCI	Join Data	Dell
SIS	OPTi	Contaq	OPTi	SIS	VLSI	OPTi	Hint	Headland
ZIF socket	None	Standard socket	ZIF socket	None	LIF socket	Standard socket	Standard socket	Standard socket
MI (11/11/92)	AMI (11/11/92)	AMI (11/11/92)	AMI (11/11/92)	AMI (6/6/92)	Compaq (2/18/93)	AMI (6/6/92)	AMI (1/15/93)	Phoenix (6/3/93)
□	□	□	□	□	□	□	□	■
MB–32MB	1MB–16MB	1MB–32MB	1MB–32MB	1MB–32MB	4MB–32MB	1MB–32MB	4MB–32MB	4MB–64MB
256K	64K	128K	256K	256K	None	128K	256K	None
ect-mapped	Two-way set-associative	Four-way set-associative	Direct-mapped	Direct-mapped	N/A	Direct-mapped	Direct-mapped	N/A
Write-back	Write-back	Write-back	Write-through	Write-back	N/A	Write-through	Write-back	N/A
3, 2	2, 1	3, 2	3, 1	2, 2	1, 1	3, 0	3, 1	2, 0
0, 3	1, 0	0, 0	0, 1	0, 1	0, 1	1, 0	0, 1	0, 1
MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	Dual	1.44MB	Dual	1.2MB, 1.44MB	1.44MB
iba XM-3401B	Mitsumi CRMC-LU005S	Texel DM-3024	Mitsumi CRMC-LU005S	Mitsumi CRMC-LU005S	LMSI CM-205	Matsushita CR-523-B	NEC CDR-84JD-1	Matsushita CR-523-B
20MB–1GB	85MB–2GB	170MB–525MB	120MB–1GB	42MB–2.6GB	120MB–340MB	85MB–1GB	250MB–1.37GB	120MB–500MB
L-Bus card	ISA card	VL-Bus card	VL-Bus card	VL-Bus card	Motherboard	Motherboard	VL-Bus card	Motherboard
2, 3, 0	1, 5, 0	0, 6, 0	1, 4, 0	2, 4, 0	0, 3, 0	0, 5, 0	0, 3, 3	0, 3, 0
2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	0, 0, 0	1, 0, 0	2, 0, 0	0, 0, 0
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 1
mond Sonic Sound	Thunder Media Thunder Audio Spectrum 16	Media Vision Pro AudioSpectrum 16	Aztech Sound Galaxy NX Pro	Creative Labs Sound Blaster 16 ASP	Media Vision Pro AudioSpectrum 16	Creative Labs Sound Blaster 16	Media Vision Pro Audio Studio 16	Creative Labs Sound Blaster 16 ASP
L-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	Motherboard LB	VL-Bus card	VL-Bus card	Motherboard LB
Weitek	S3	Cirrus Logic	Cirrus Logic	S3	Tseng	Weitek	Tseng	Tseng
■■	■■	■■	■■	■■	■■	■■	■■	■■
5 years	1 year	1 year	1 year	1 year parts, 5 years labor	3 years	1 year	3 years parts, lifetime labor	1 year
58 (1 year)	Included (1 year)	Included (1 year)	N/A	$149 (1 year)	Included (1 year)	$99 (1 year)	$30 (1 year)	Included (1 year)

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CIRCLE 368 ON READER SERVICE CARD

IT'S NOT JUST PRINTING,
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SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	Diamond DT 486C-40 Multimedia	Digitech Opusis 4D33 Multimedia System	DTK Feat-3303/S33	Duracom Multimedia DeskSaver 486/33SX	Dyna Micro DMS486DX/250	Eltech Model 486SLC2-66
List price (tested configuration)	$2,359	$2,350	$2,749	$2,745	$2,240	$1,779
Processor type and speed	Cyrix 486S-40	Intel 486DX/33	Intel 486SX/33	Intel 486SX/33	Intel 486DX2/50	IBM 486SLC2-66
Hard disk capacity	251MB	210MB	240MB	212MB	212MB	240MB
Dealers/Direct-distribution channel	□■	■■	■□	■□	■■	□■
Case style	Tower	Desktop	Desktop	Small-footprint	Desktop	Mini-tower
Bus architecture	ISA	ISA	ISA	ISA	ISA	ISA
Power supply (and number of connectors)	230W (5)	200W (5)	200W (8)	200W (5)	200W (5)	250W (4)
Motherboard and CPU						
Motherboard manufacturer	Dennow	Gigabyte	DTK	DFI	Addonics, ASUS	Alaris
Chip set manufacturer	OPTi	UMC	DTK	Contaq	SIS	OPTi
Processor upgrade path	Standard socket	None	Standard socket	ZIF socket	ZIF socket	None
BIOS version (or date)	AMI (3/3/93)	AMI (11/11/92)	AMI (2/11/93)	AMI (11/11/92)	AMI (11/11/92)	AMI (6/6/92)
Flash memory	□	□	□	□	□	□
Memory and Processor RAM Cache						
Installable RAM on motherboard	4MB–32MB	1MB–32MB	1MB–32MB	1MB–32MB	1MB–32MB	2MB–16MB
External RAM cache installed	256K	256K	256K	256K	256K	128K
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Cache write design	Write-back	Write-back	Write-back	Write-back	Write-back	Write-back
Disk Drives						
Accessible drive bays (5.25", 3.5")	3, 2	2, 1	3, 2	3, 1	3, 1	2, 2
Internal drive bays (5.25", 3.5")	0, 2	0, 1	1, 1	0, 2	0, 1	0, 2
Floppy disk drives	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB
CD-ROM drive manufacturer and model	Toshiba XM-3401B	Mitsumi CRMC-LU005S	Texel DM-3024	NEC CDR-84JD-1	Mitsumi CRMC-LU005S	Mitsumi CRMC-LU005S
Hard disk options	120MB–1GB	170MB–540MB	120MB–2GB	83MB–1.4GB	120MB–500MB	120MB–1GB
Disk controller location	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card
Expansion Bus						
8-bit, 16-bit, 32-bit slots	2, 3, 0	1, 3, 0	1, 4, 0	2, 4, 0	0, 5, 0	1, 5, 0
VESA, PCI, proprietary bus slots	3, 0, 0	3, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
Sound card manufacturer and model	Creative Labs Sound Blaster Pro	Thunder Media Thunder Audio Spectrum 16	Creative Labs Sound Blaster Pro	Media Vision Pro Audio Studio 16	Aztech Sound Galaxy NX Pro 16	Thunder Media Thunder Audio Spectrum 16
Video						
Display circuitry location	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card
Video chip set manufacturer	Tseng	S3	Weitek	ATI	S3	Cirrus Logic
Miscellaneous						
DOS 6.0/ Microsoft Windows 3.1 included	■■	■■	■■	■■	■■	■■
Warranty	15 months parts, 2 years labor	2 years	1 year	1 year	1 year	1 year
On-site service charge	$75 (1 year)	N/A	$50 (1 year)	Included (1 year)	$150 (1 year)	$69 (1 year)

N/A—Not applicable. The product does not have this feature. ATI—ATI Technologies Inc., Asus—Asus Tek Computer Inc., C&T—Chips & Technologies Inc., DFI—DFI Inc., ECS—Elite Group Computer Systems Inc., EFA—EFA Corp. of Am
IIT—Integrated Information Technologies, MCCI—Micro Center Computer Inc. SCI—SCI Systems Inc., SIS—Silicon Integrated Systems Corp., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital Corp.

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Multimedia 86-DX2/66 VLB	Epson Endeavor WG	FutureTech System 452eV	Gateway 2000 4DX2-66V	HiQ Multimedia Multimagic System	Hi-Tech 486DX2-66 EISA/VLB MPC	IBM Multimedia for ValuePoint (MVP Series)	Image M-Line 486DX2-66VL	Insight 486DX2-66 VL-Bus Multimedia
$2,655	$2,529	$2,729	$2,749	$2,725	$2,745	$2,743	$2,690	$2,749
l 486DX2/66	Intel 486SX/33	Intel 486DX2/50	Intel 486DX2/66	Intel 486DX/33	Intel 486DX2/66	Intel 486SX/25	Intel 486DX2/66	Intel 486DX2/66
245MB	244MB	245MB	340MB	250MB	211MB	245MB	255MB	340MB
□■	□■	■■	□■	□■	■■	■■	□■	□■
Desktop	Desktop	Mini-tower	Desktop	Tower	Desktop	Desktop	Mini-tower	Tower
ISA	ISA	EISA	ISA	ISA	ISA	ISA	ISA	ISA
200W (6)	145W (4)	250W (5)	200W (6)	250W (8)	230W (8)	204W (5)	230W (8)	250W (6)
EPS	Epson	Mars Technology	Micronics	Micronics	MicroCenter	IBM	Gigabyte	ASUS
UMC	UMC	Hint, Samsung	Micronics	Micronics	Hint, OPTi	IBM, Intel	UMC	SIS
ZIF socket	ZIF socket	ZIF socket	ZIF socket	Standard socket	ZIF socket	ZIF socket	ZIF socket	ZIF socket
ll (11/11/92)	Epson 106.109	AMI (1/15/93)	Phoenix 0.10 GJX30-05E	Phoenix 0.10 G22-2 LB	AMI (2/17/93)	IBM (5/13/93)	AMI (11/11/92)	AMI (11/11/92)
□	□	□	■	■	□	■	□	□
MB–32MB	4MB–128MB	4MB–128MB	4MB–64MB	4MB–64MB	1MB–128MB	1MB–64MB	1MB–32MB	256K–32MB
256K	None	256K	256K	256K	256K	None	256K	256K
ect-mapped	N/A	Direct-mapped	Direct-mapped	Direct-mapped	Four-way set-associative	N/A	Direct-mapped	Four-way set-associative
Write-back	N/A	Write-back	Posted write-through	Write-through	Write-back	N/A	Write-back	Write-back
2, 2	2, 0	4, 0	5, 0	4, 0	3, 0	2, 1	3, 2	6, 0
2, 0	0, 1	2, 1	0, 0	3, 0	0, 2	0, 1	1, 2	2, 0
MB, 1.44MB	Dual	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
MSI CM-205	Sony CDU31A-02	Texel DM-3024	LMSI CM-205	Toshiba XM-3401B	Texel DM-3024	Matsushita CR-563-B	Toshiba XM-3401B	Texel DM-3024
OMB–3.1GB	120MB–244MB	255MB–2GB	170MB–1GB	40MB–3.5GB	200MB–1.7GB	120MB–340MB	212MB–520MB	80MB–2.9GB
L-Bus card	Motherboard	VL-Bus card	Motherboard	Motherboard	VL-Bus card	Motherboard	ISA card	VL-Bus card
1, 3, 0	0, 4, 0	0, 2, 4	0, 5, 0	0, 6, 0	0, 6, 0	0, 4, 0	1, 3, 0	0, 5, 0
3, 0, 0	0, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	1, 0, 0	3, 0, 0	2, 0, 0
1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 0
dia Vision Pro oSpectrum 16	Media Vision Pro AudioSpectrum 16	Media Vision Pro AudioSpectrum 16	Microsoft Windows Sound System	Media Vision Pro Audio Studio 16	Creative Labs Sound Blaster 16 ASP	Creative Labs Sound Blaster 16	Media Vision Pro Audio Studio 16	Media Vision Pro AudioSpectrum 16
L-Bus card	Motherboard LB	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	Motherboard VL-Bus	VL-Bus card	VL-Bus card
Weitek	C&T	Weitek	ATI	ATI	Weitek	S3	S3	Cirrus Logic
■■	■■	■■	■■	■■	■■	■■	■■	■■
years parts, year labor	1 year	15 months	1 year	1 year parts, 2 years labor	1 year parts, 2 years labor	1 year	1 year parts, lifetime labor	1 year
uded (1 year)	Included (1 year)	$79 (1 year)	Included (1 year)	Included (1 year)	N/A	Included (1 year)	N/A	N/A

Finally, A Notebook That Aren't

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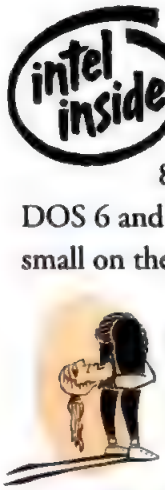
PC/Computing, July 1993.

COMPUDYNE SUBNOTE: A POWER-PACKIN' PROCESSOR IN A PENCIL-PUSHIN' PACKAGE

For those who would rather develop third quarter projections than triceps, Compudyne offers the most powerful processor available in a subnotebook—the Intel486™SL at 25 MHz—in a tiny 3.9 pound package. Subnote adds an on-board math co-processor, 4MB of RAM, 8K of cache memory, an 80 MB removable hard drive, and Microsoft® DOS 6 and Windows™ 3.1, so it's big on the inside, but small on the outside.



FLEXIBILITY

Subnote has an internal expansion compartment, a PCMCIA II slot, and more ports than most wine shops: parallel, RJ11, serial, external floppy, AC adapter, PS/2™ mouse/keyboard, and VGA. Its 3.5", 1.44 MB external floppy drive comes standard.

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Not straining your back doesn't mean you have to strain your eyes. Subnote has a built-in 640 x 480 VGA backlit LCD screen with an 18 to 1 contrast ratio, plus a handy LCD indicator panel for system status.

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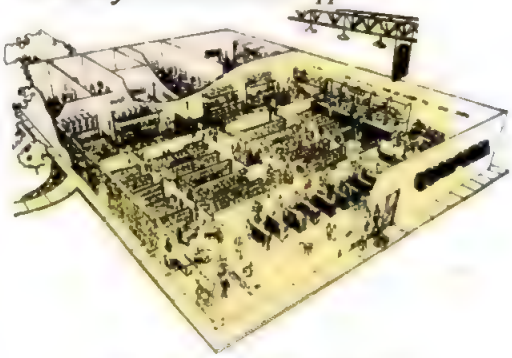

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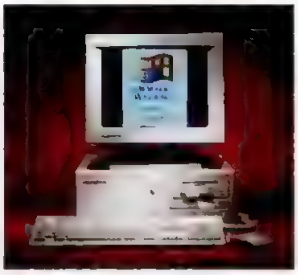

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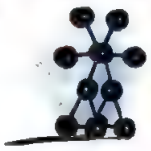

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Our monochrome Slimnote is slightly thinner (at 1.6") and weighs in at only 5.8 pounds with its 10" VGA 640 x 480 brilliant LCD screen.

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PCM1032

SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

	PC MAGAZINE EDITORS' CHOICE International Instrumentation Blue Max Multimedia Monolith	Mega R486/33-MPC	MicroFLEX-VL/Multimedia	Micro Generation 486 VL-Bus Multimedia System	Micron 466VL Magnum MPC	Mitsuba Multi-Pro 486DX/33
List price (tested configuration)	$2,699	$2,313	$2,550	$2,695	$2,748	$2,495
Processor type and speed	Intel 486DX/33	Intel 486DX/33	Intel 486DX2/66	Intel 486DX/33	Intel 486DX2/66	Intel 486DX/33
Hard disk capacity	251MB	210MB	212MB	250MB	245MB	251MB
Dealers/Direct-distribution channel	■■	■■	□■	■■	■■	■□
Case style	Mini-tower	Slimline	Mini-tower	Desktop	Desktop	Desktop
Bus architecture	ISA	ISA	ISA	ISA	ISA	ISA
Power supply (and number of connectors)	250W (6)	145W (5)	200W (8)	250W (5)	200W (5)	200W (4)
Motherboard and CPU						
Motherboard manufacturer	Young Micro	Intel	Forex	MCCI	Micronics	Mitsuba
Chip set manufacturer	Symphony	VLSI	Forex	Hint	Micronics	SIS
Processor upgrade path	ZIF socket	ZIF socket	Standard socket	ZIF socket	ZIF socket	ZIF socket
BIOS version (or date)	AMI (6/6/92)	Phoenix 1.00.02.ACO	AMI (11/11/92)	AMI (2/17/93)	Phoenix 0.10 JX30-05	AMI (6/6/92)
Flash memory	□	■	□	□	■	□
Memory and Processor RAM Cache						
Installable RAM on motherboard	1MB–32MB	4MB–32MB	8MB–32MB	1MB–128MB	4MB–64MB	4MB–32MB
External RAM cache installed	256K	128K	256K	256K	256K	256K
Cache architecture	Two-way set-associative	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Cache write design	Write-through	Write-back	Write-back	Write-back	Write-through	Write-back
Disk Drives						
Accessible drive bays (5.25", 3.5")	2, 2	2, 1	3, 2	3, 1	3, 0	3, 0
Internal drive bays (5.25", 3.5")	0, 1	0, 1	0, 1	0, 1	0, 2	0, 1
Floppy disk drives	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	Dual	Dual
CD-ROM drive manufacturer and model	Toshiba XM-3401B	Matsushita CR-522-B	NEC Multispin 84	Mitsumi CRMC-LU005S	Chinon CDS-535	Mitsumi CRMC-LU005S
Hard disk options	43MB–2.4GB	80MB–1.2GB	170MB–2.4GB	340MB–520MB	245MB–1.2GB	80MB–1.3GB
Disk controller location	VL-Bus card	Motherboard	VL-Bus card	VL-Bus card	Motherboard	VL-Bus card
Expansion Bus						
8-bit, 16-bit, 32-bit slots	0, 5, 0	0, 3, 0	1, 5, 0	0, 5, 1	0, 5, 0	0, 5, 0
VESA, PCI, proprietary bus slots	3, 0, 0	0, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0
Parallel, serial, mouse ports	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1
Sound card manufacturer and model	Creative Labs Sound Blaster 16 ASP	Aztech Sound Galaxy NX Pro 16	Creative Labs Sound Blaster 16 ASP	Thunder Media Thunder Audio Spectrum 16	Creative Labs Sound Blaster 16 ASP	Thunder Media Thunder Audio Spectrum 16
Video						
Display circuitry location	VL-Bus card	Motherboard LB	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card
Video chip set manufacturer	Cirrus Logic	Cirrus Logic	ATI	ATI	Weitek	Tseng
Miscellaneous						
DOS 6.0/ Microsoft Windows 3.1 included	■■	■■	■■	■■	■■	■■
Warranty	1 year	1 year	2 years	1 year parts, lifetime labor	1 year	2 years
On-site service charge	Included (1 year)	$365 (1 year)	$50 (1 year)	$65 (1 year)	Included (1 year)	$25 (1 year)

N/A—Not applicable: The product does not have this feature. ATI—ATI Technologies Inc., Asus—Asus Tek Computer Inc., C&T—Chips & Technologies Inc., DFI—DFI Inc., ECS—Elite Group Computer Systems Inc., EFA—EFA Corp. of A
IIT—Integrated Information Technologies, MCCI—Micro Center Computer Inc., SCI—SCI Systems Inc., SIS—Silicon Integrated Systems Corp., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital Cor

ENDS

E486DX2-66V	National MicroComputers Universal Pro-System	National Micro Flash 486DX-33MPC	NETiS N4D266VL	Poly 486-66EM	Tangent Black Box Obsidian	UM Galaxy 486VLB-33MM	UT-66VLM	Vektron Business Multimedia
$2,750	$2,743	$2,500	$2,435	$2,749	$2,599	$2,549	$2,750	$2,750
el 486DX2/66	Intel 486DX/33	Intel 486DX/33	Intel 486DX2/66	Intel 486DX2/66	Cyrix 486S-40	Intel 486DX/33	Intel 486DX2/66	Intel 486DX/33
240MB	240MB	245MB	212MB	340MB	245MB	213MB	255MB	345MB
□■	■■	□■	■■	■■	■■	□■	□■	■■
Tower	Desktop	Desktop	Desktop	Tower	Tower	Mini-tower	Mini-tower	Tower
ISA	ISA	ISA	ISA	EISA	EISA	ISA	ISA	ISA
120W (8)	200W (4)	200W (4)	230W (5)	250W (7)	230W (5)	230W (6)	220W (6)	250W (7)
Micronics	ECS	Tyan	Free Technology	MCCI	MCCI	Addonics	Micro Center	ACIO Impression
Micronics	UMC	SIS	SIS	Hint	Hint	SIS	Contaq, SIS	USA Integration
ZIF socket	ZIF socket	Standard socket	Standard socket	ZIF socket	ZIF socket	ZIF socket	ZIF socket	Standard socket
enix (4/19/90)	AMI (3/25/93)	AMI (11/11/92)	AMI (6/6/92)	AMI (7/7/91)	AMI (4/3/93)	AMI (5/5/91)	AMI (6/6/92)	AMI (6/6/92)
□	□	□	□	□	□	□	□	□
MB–64MB	1MB–32MB	1MB–64MB	1MB–32MB	4MB–128MB	1MB–128MB	1MB–32MB	1MB–32MB	1MB–32MB
256K	256K	256K	256K	256K	256K	256K	256K	256K
Four-way t-associative	Direct-mapped	Direct-mapped	Direct-mapped	Four-way set-associative	Direct-mapped	Two-way set-associative	Direct-mapped	Direct-mapped
Write-back	Write-back	Write-back	Write-back	Write-through	Write-back	Write-back	Write-back	Write-back
3, 2	3, 0	2, 1	3, 2	3, 2	3, 2	3, 2	3, 3	6, 0
0, 2	0, 2	0, 1	0, 2	0, 2	0, 2	0, 1	0, 0	3, 0
Dual	Dual	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
xel DM-3024	Procom DR0020	Mitsumi CRMC-LU005S	Matsushita CR-523-B	Matsushita CR-562-B	NEC CDR-55JD	Mitsumi CRMC-LU005S	NBC CDR-MV8	Matsushita CR-523-B
00MB–2GB	240MB–1.2GB	130MB–1.6GB	130MB–535MB	170MB–1.2GB	170MB–4GB	120MB–340MB	170MB–345MB	245MB–535MB
/L-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card
0, 6, 0	0, 6, 0	0, 7, 0	2, 4, 0	0, 5, 1	0, 5, 1	0, 5, 0	1, 5, 0	1, 5, 0
2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0	2, 0, 0
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
dia Vision Pro ioSpectrum 16	Media Vision Pro AudioSpectrum 16	Aztech Sound Galaxy NX Pro 16	Creative Labs Sound Blaster Pro	LaserWave Supra 16	Media Vision Pro AudioSpectrum 16	Aztech Sound Galaxy NX Pro 16	Media Vision Pro AudioSpectrum 16	Creative Labs Sound Blaster 16
/L-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card
Weitek	S3	WD	Cirrus Logic	S3	IIT	S3	S3	ATI
■■	■■	■■	■■	■■	■■	■■	■■	■■
1 year	1 year parts, 2 years labor	15 months parts, 2 years labor	1 year	2 years parts, 5 years labor	1 year	1 year parts, 2 years labor	1 year parts, lifetime labor	1 year parts, lifetime labor
N/A	$39 (1 year)	$70 (1 year)	$150 (1 year)	$75 (1 year)	Included (1 year)	N/A	Included (1 year)	Included (1 year)

drive bays. Our test unit came with a dual 1.2MB/1.44MB floppy disk drive in one bay. The unit is paired with an ADI 4G 15-inch monitor, capable of displaying 1,280-by-1,024 resolution at 72 Hz. The supplied mouse is of low quality and is comfortable only to users with smaller hands.

The system is available with six different CPUs, from 486SX/25 to 486DX2/66. The motherboard comes standard with 256K of external processor cache. The NMC also offers six 16-bit ISA and two VL-Bus slots. An S3-based Actix Graphics Engine 32VL VL-Bus video adapter is included with 2MB DRAM.

National Micro-Computers Universal Pro-System

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR
Multimedia	GOOD

The NMC comes with one of the better sound boards used in this roundup, the Media Vision Pro AudioSpectrum 16 Multimedia Sound Card. Unlike many other systems, we found the sound quality to have low distortion and a wide frequency response. The NMC also came with a Procom double-speed CD-ROM drive and a set of fair-quality Media Resources speakers. The sound board and CD-ROM produced good sound quality.

On most performance tests, the NMC turned in average scores, but it stood out in two areas. The NMC came with a Promise Technology VL-Bus IDE controller with 2MB of cache RAM and a Quantum Prodrive LPS 240AT 240MB hard disk. This pair turned in the fifth best disk score of all test units. The CD-ROM was also one of the best we saw in this roundup.

The NMC comes with several CD-ROM applications, including Multimedia Encyclopedia. It also offers a nice CD-ROM/sound board pair, a critical multimedia element.—*SP*

FACT FILE

National MicroComputers Universal Pro-System

National MicroComputers, 3855 S. 500 West, Salt Lake City, UT 84115; 800-424-2983, 801-265-3700; fax, 801-265-3783

List price (tested configuration): $2,743.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Quantum ProDrive LPS 240AT 16-ms 240MB IDE hard disk with 256K cache, Promise Technology DC-4030VL-1 disk controller with 2MB cache, dual 1.2MB/1.44MB floppy disk drive

Display: Actix Graphics Engine 32VL video controller with 2MB dynamic RAM, ADI 4G 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, ChessMaster 3000, Mavis Beacon Teaches Typing, Software Toolworks Atlas Pack.

In short: A high-quality sound board and high-performance CD-ROM drive make the National MicroComputers Universal Pro-System one of the best multimedia systems in this roundup

479 ON READER SERVICE CARD

National Micro Systems Inc.

Flash 486DX-33MPC

With built-in speakers and front-mounted volume controls, the $2,500 Flash 486DX-33MPC looks more like a multimedia PC than most tested systems do. As a general PC, it delivers some good component performance, but its sound quality disappoints.

National Micro Flash 486DX-33MPC

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	GOOD
Multimedia	POOR

This desktop unit catches the eye with curved speaker grills on each side. The speakers behind them, however, are barely larger than a standard internal PC speaker. There are three accessible drive bays, occupied by a 1.2MB floppy disk, 1.44MB floppy disk, and CD-ROM drive.

Bundled with the system are several multimedia applications, headphones, and a microphone. National Micro Systems provided a decent pair of Juster Active SP 680 external speakers, which cost an extra $95.

The motherboard comes with 256K of external cache, upgradable to 512K or 1MB. Supplied with a 486DX/33, this unit is also available with other CPUs, including a 486DX2/66 for an extra $240. Also provided is an AOC 15-inch monitor.

The Flash produced impressive DOSmark scores, resulting from strong disk and video scores. The Western Digital-based Prolink VL-Bus video board produced a video score of 12.2 million operations per second. Loaded with 2MB of cache memory, a Promise VL-Bus IDE caching controller, and a Seagate ST-

FACT FILE

Flash 486DX-33MPC

National Micro Systems Inc., 2979-B Pacific Dr., Norcross, GA 30071; 800-642-7649, 404-446-0520; fax, 404-449-5297

List price (tested configuration): $2,500.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Seagate ST-3283A 12-ms 245MB IDE hard disk with 64K cache, Promise DC-4030VL disk controller with 2MB cache, 1.2MB and 1.44MB floppy disk drives.

Display: Prolink WD 33VL VESA local-bus card video controller with 1MB DRAM, AOC CM-536 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, The Animals!, ChessMaster 3000, HSC Interactive, Compton's MultiMedia Encyclopedia, Mavis Beacon Teaches Typing, Software Toolworks Atlas Pack.

In short: Excellent test scores make this system a strong performer, but poor sound quality makes it unsuitable for demanding multimedia applications.

478 ON READER SERVICE CARD

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is one of the thinnest color notebooks on the market — 1.77 inches. Its footprint measures only 11.7 x 8.5 inches, and it weighs under 5.7 pounds.

486 Power

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The ColorBook includes a built-in track ball, which is much easier to use than a mouse in most portable situations. You also get two PCMCIA Type II card slots so you can plug in dozens of available PCMCIA peripherals.

intel inside

Greener Pastures

The grass *is* greener on the ColorBook side of the fence! It's an extraordinary value even by Gateway's standards — and we wrote the book on value! We have a reputation for offering the best prices on high-quality products with exceptional service from friendly folks in the Midwest. That's why the choice of a computer supplier is black-and-white, even when you're buying a color notebook! Give us a call.

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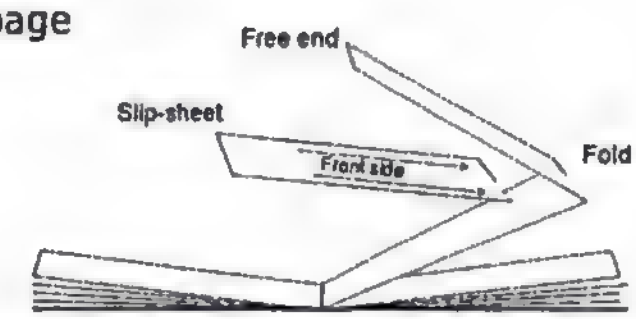
1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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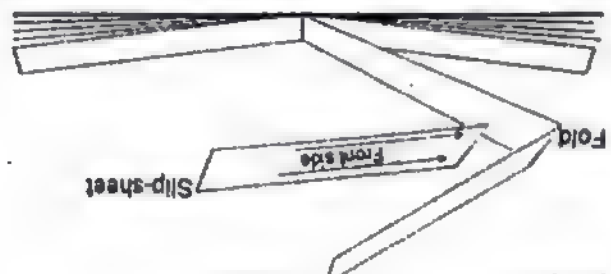

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Back

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Inverted Back

1. Follow instructions on the other side

Introducing The ColorBook!

For the same money, you can have a black-and-white 486 notebook. Or you can have a color 486 notebook. Which is it going to be? Hay, it's not too hard to spot the best deal: the ColorBook from Gateway 2000! The new ColorBook has everything you're looking for in a portable at a price you'd expect to pay for a monochrome system. That's a special breed!

Exploding The Myth

Why do you expect to pay so much more for a color portable? Because other manufacturers always charge a plump premium for color. They've been milking the market, brainwashing you into thinking high-quality color costs a lot more to manufacture. It doesn't! We're selling the ColorBook for our usual cost-plus-small-margin. Now other companies will have a hard time perpetuating the color portable price myth. (Competitors absolutely *hate* us! Isn't it great?)

Experts' Reaction

We gave several PC trade publication editors a sneak preview of the ColorBook. Here's what they said about it: "Way cool!" "Dead on." "You won't be able to make enough of these."

Dazzling Color Display

The editors were impressed by the bright, crisp color graphics from the latest-technology, dual-scan STN display. It's a 9.4-inch VGA LCD, backlit for use in any lighting conditions. The editors said the ColorBook has the best STN color display they had ever seen! When they learned one model was priced *less than $2,000*, they were convinced the ColorBook will cause a stampede in the industry.

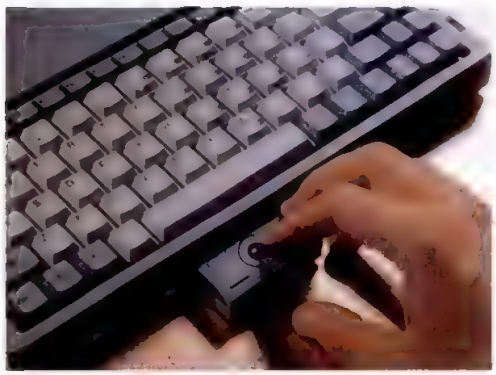
No Compromise On Size

Adding color to a portable usually means adding weight and bulk. Not so with the Gateway 2000 ColorBook. The ColorBook

Introducing The ColorBook!

The ColorBook is one of the thinnest color notebooks on the market — 1.77 inches. Its footprint measures only 11.7 x 8.5 inches, and it weighs under 5.7 pounds.

You'll appreciate the convenience of using PCMCIA cards. They're as easy to carry as credit cards, and they plug right into your ColorBook.



The integrated track ball slides out from a compartment by the space bar on the keyboard. You simply pull it out and go to work. Finished? Just slide the track ball back into the ColorBook.

FEATURES

Size

With the ColorBook, you get great color at a great price while maintaining excellent portability.

SL Enhanced Intel 486® Processor

ColorBook notebooks are based on Intel's new SL technology 486 microprocessors, which makes them powerful enough to serve as your desktop PC with an external mouse, keyboard and monitor. Supports simultaneous video on an external monitor at 640 x 480 resolution.

Dual-Scan STN Color Display

Dual-scan STN color is the latest technology in portable color displays, and it looks fabulous! You get 256 colors with the ColorBook running in VGA mode.

PCMCIA Type II Slots

Add a modem, network card or any of dozens of available PCMCIA-compatible peripherals. The ColorBook's two Type II slots can also be used for one Type III PCMCIA card.

COLORBOOK

- Weight: Under 5.7 Lbs.
- Dimensions: 11.7" x 8.5" x 1.77"
- SL Enhanced Intel 486 Processor
- 4MB RAM (expandable to 20MB)
- 3.5" 1.44MB Diskette Drive
- Removable Hard Drive
- 9.4" Backlit VGA Dual-Scan STN Color Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 2 PCMCIA Type II Slots
- Integrated Track Ball (2 Buttons)
- 85-Key Keyboard
- Parallel, Serial & PS/2 Mouse Ports
- External CRT Port
- MS-DOS®6 and Windows™3.1

486SX-25

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486SX-33

- 33MHz SL Enhanced Intel 486SX Processor
- 170MB IDE Hard Drive

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486DX-33

- 33MHz SL Enhanced Intel 486DX Processor
- 170MB IDE Hard Drive

$2695

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- Extra NiMH Battery

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With PCMCIA TelePath™ Fax/Modem

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COMBO PACK

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- MS Mouse
- 15" Color CrystalScan 1572FS

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Options include: PCMCIA fax/modem cards, PCMCIA network cards, 4MB or 16MB RAM upgrades, carrying case and extra NiMH batteries. Call for details.

intel inside

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3283A 245MB hard disk, the system achieved a disk score of 131K per second.

The Flash's results on our sound and CD-ROM tests were not as impressive. The Aztech Sound Galaxy Pro 16 sound board exhibited a very low cutoff in high-frequency output. The Mitsumi single-speed CD-ROM drive was a very slow performer; a Toshiba dual-speed drive is available for $250. Sound quality was deemed unacceptable.

The Flash offers high performance but wastes space on poor-quality speakers. Sound board limitations may restrict this unit to business audio.—*SP*

NETiS Technology Inc.

NETiS N4D266VL

The NETiS N4D266VL is an inexpensive system, that, at $2,450 (including speakers), is priced less than many units with fewer capable processors. But the system is hampered by uneven performance results and a poor sound system.

The NETiS comes in a desktop case with three half-height and two 3.5-inch drive bays, all accessible. The included keyboard has a low-quality feel, and the ETC monitor is also of modest quality with its 14-inch screen and lack of support for 1,280-by-1,024 resolution. The Free Technology motherboard in the NETiS offers a 256K external processor RAM cache and six ISA and two VL-Bus slots and uses a fan-cooled heat sink on the 66-MHz CPU, but it can accomodate a maximum of 32MB of RAM on the system board.

NETiS N4D266VL

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	FAIR
Expandability	FAIR
Multimedia	POOR

The test unit we received had a Creative Labs Sound Blaster Pro board, Matsushita single-speed CD-ROM drive, and low-quality JS J-003 speakers. The sound board showed severe clipping problems in our sound testing, leading to this unit's unacceptable sound quality rating. The test unit did have a good selection of multimedia software, including Sherlock Holmes Consulting Detective, Microsoft Bookshelf, and Macromedia's Action!

The Genoa 8500/VL VL-Bus video adapter produced a relatively poor score of 9.26 megapixels per second on our Graphics Winmark test. The Matsushita CD-ROM drive also produced lower-tier performance results. In contrast, the Western Digital Caviar 2200 IDE drive and Promise Technology caching VL-Bus IDE adapter produced exceptionally good scores, surpassed only by the Blue Max Multimedia Monolith.

The NETiS, with its mixed bag of performance and sound quality, is more suitable for games and business applications than for applications with high-quality audio demands. If the former is all you need, the NETiS is a reasonable choice.—*SP*

FACT FILE

NETiS N4D266VL

NETiS Technology Inc.,
1606 Centre Pointe Dr., Milpitas, CA 95035;
408-263-0368; fax, 408-263-4624

List price (tested configuration): $2,435

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Western Digital Caviar 2200 15-ms 212MB IDE hard disk with 64K cache, Promise DC-4030VL-1 disk controller with 2MB cache, and 1.2MB and 1.44MB floppy disk drives

Display: Genoa WindowsVGA 24 8500VL video controller with 1MB DRAM, ETC CA-1460 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, Creative Sounds Prosonus, Microsoft Bookshelf, Microsoft Works for Windows, Sherlock Holmes, and other CD-ROM titles

In short: The NETiS N4D266VL offers some strong performance characteristics and a wide variety of software, but poor sound quality and limited video restrict its multimedia capabilities.

480 ON READER SERVICE CARD

Polywell Computers Inc.

Poly 486-66EM

The Poly 486-66EM, from Polywell Computers, provides middle-of-the-pack performance, but the quality of sound is limited by the vendor's choice of CD-ROM drive, and, at $2,749, the Poly is priced at the upper end of our roundup criteria.

The Poly uses a full tower case, which provides three half-height and two 3.5-inch accessible drive bays. Unfortunately, the case design hinders access to an I/O slot on the motherboard. The NICE 4586 system board in the Poly offers three EISA slots (2 of which double as VL-Bus slots) and five 16-bit ISA slots. A third EISA slot can't take a full-length board, due to the proximity of the hard disk. The system board comes standard with 256K of external processor cache, expandable to 1MB. There are other upgrade features as well. The board can handle up to 128MB of system RAM, and there is a ZIF socket, presumably to handle the upcoming P24T Pentium OverDrive chip.

Poly 486-66EM

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	EXCELLENT
Multimedia	POOR

The Poly was the only unit in this roundup to include a LaserWave Supra 16 sound board. This board had acceptable distortion and signal-to-noise characteristics but a low high-frequency cutoff. What really limits the board, however, is the Matsushita double-speed CD-ROM drive, which produced an extremely low-amplitude audio signal. Any amplification to compensate for this would only add noise to the signal. Both board and CD-ROM drive combined to produce poor overall sound quality.

The Poly system turned in average scores on most of our benchmark tests. The Orchid 1280VLB VL-Bus video adapter turned in an adequate 12 megapixels per second on our Graphics Winmark test. The system also produced a below-average score on the Windows Applications test.

Although offering some nice expan-

FACT FILE

Poly 486-66EM

Polywell Computers Inc., 61-C Airport Blvd., San Francisco, CA 94080; 800-999-1278, 415-583-7222; fax, 415-583-1974

List price (tested configuration): $2,749.

Memory and processor RAM cache: 8MB 60-ns SIMMs 256K external cache.

Disk drives and controller: Western Digital Caviar 2340 13-ms 340MB IDE hard disk with 64K cache, Morse 8002 VESA local-bus hard disk controller card with 64K cache, 1.2MB and 1.44MB floppy disk drives.

Display: Orchid 1280VLB VL-bus card video controller with 1MB DRAM, Polywell CAC14MG 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Microsoft Windows 3.1, AudioStation, ChessMaster 3000, Mavis Beacon Teaches Typing, Monologue for Windows, Quick Sound Test, Software Toolworks Atlas Pack, Voyetra Multimedia Toolkit, WinDAT.

In short: The pricey Poly 486-66EM's components are poorly matched, and sound quality is limited. This is offset by the system's extensive bundled software.

461 ON READER SERVICE CARD

sion features, the Poly's components do not complement each other well. Bottlenecked audio from the CD-ROM drive makes this unit undesirable for demanding multimedia.—*SP*

Tangent Computer Inc.

Tangent Black Box Obsidian

The $2,599 Tangent Black Box Obsidian is one of two units reviewed in this issue that utilizes the Cyrix CX486S-40 processor. Unfortunately, the system's poor sound quality and mediocre overall performance make this unit a disappointment.

The Obsidian wins the award for the best-dressed PC, sporting an all-black finish from monitor to speakers. It comes in a tower case that provides three half-height and two 3.5-inch accessible drive bays and two 3.5-inch internal bays. Included with the unit was an Axxis 14-inch monitor capable of 1,280-by-1,024 resolution at a 60-Hz refresh rate in noninterlaced mode. Although the Obsidian's keyboard has a shaky feel, the included three-button mouse is comfortable, shaped essentially like the older style Microsoft mouse.

Tangent Black Box Obsidian

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	EXCELLENT
Multimedia	POOR

The Obsidian utilizes a NICE motherboard that is capable of handling 128MB of system RAM. In addition, 256KB of 20-ns external processor RAM cache was present on the system we tested, along with 70-ns SIMMs for system memory. The NICE motherboard features five ISA 16-bit slots, one EISA slot, and a pair of VL-Bus slots. The Tangent technical documentation included with the system is excellent, covering jumper settings, connections to various IDE drives, and cache optimization for different operating systems.

Included was a Media Vision Pro Audio Studio 16 sound board, which exhibited severe clipping. It was coupled with an NEC double-speed CD-ROM drive which turned in low data-throughput results. The Tangent came with a $195 pair of high-quality cylindrical Sony SRS-88 30W speakers. Overall sound quality was judged to be unacceptable.

The Obsidian's performance scores ranged from poor to average, but none rose above average. The Hercules Graphite video board turned in a relatively poor score on our DOS VGA tests and an acceptable 14-megapixel-per-second score on our Graphics Winmark tests.—*SP*

FACT FILE

Tangent Black Box Obsidian

Tangent Computer Inc., 197 Airport Blvd., Burlingame, CA 94010; 800-800-5550, 415-342-9388; fax, 415-342-5937

List price (tested configuration): $2,599.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Seagate ST3283A 12-ms 245MB IDE hard disk with 256K cache, Tyan VL400GWF/S1339 VESA local-bus hard disk controller card with 16K cache, 1.44MB floppy disk drive.

Display: Hercules Graphite Card VESA local-bus card video controller with 1MB video RAM, Axxis PT1 14-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 resolution.

Software: DOS 6.0, Microsoft Windows 3.1, Battle Chess, Broderbund's Living Books, Compton's Interactive Encyclopedia.

In short: Despite its components' high-tech black look, this system doesn't offer the high-quality sound or strong performance expected in a multimedia PC.

462 ON READER SERVICE CARD

United Micro

UM Galaxy 486VLB-33MM

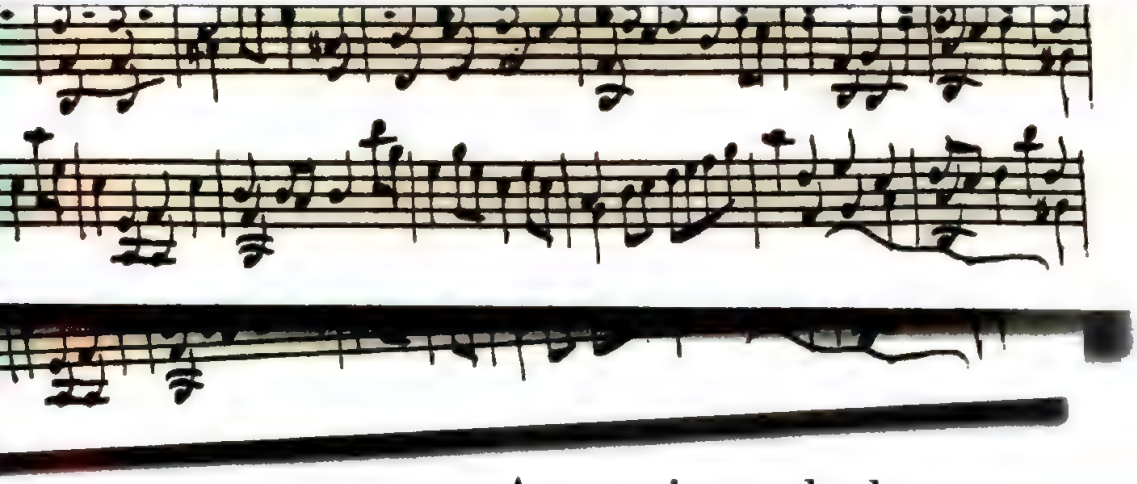
The $2,549 UM Galaxy 486VLB-33MM from United Micro barely managed to give average performance and fell short of the performance required of a PC with multimedia aspirations.

Housed in a mini-tower case, the 486DX/33-based Galaxy includes an Addonics motherboard with 256K of 20-ns external processor RAM cache. The case offers three half-height and two 3.5-inch accessible drive bays. An Addonics 15-inch monitor and a low-cost Logitech mouse were also included in the tested configuration.

UM Galaxy 486VLB-33MM

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR
Multimedia	POOR

The Mitsumi single-speed CD-ROM



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to get in tune.

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is fiddling around

on their own.

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everyone seems to be marching to their own drummer.

Sound familiar?

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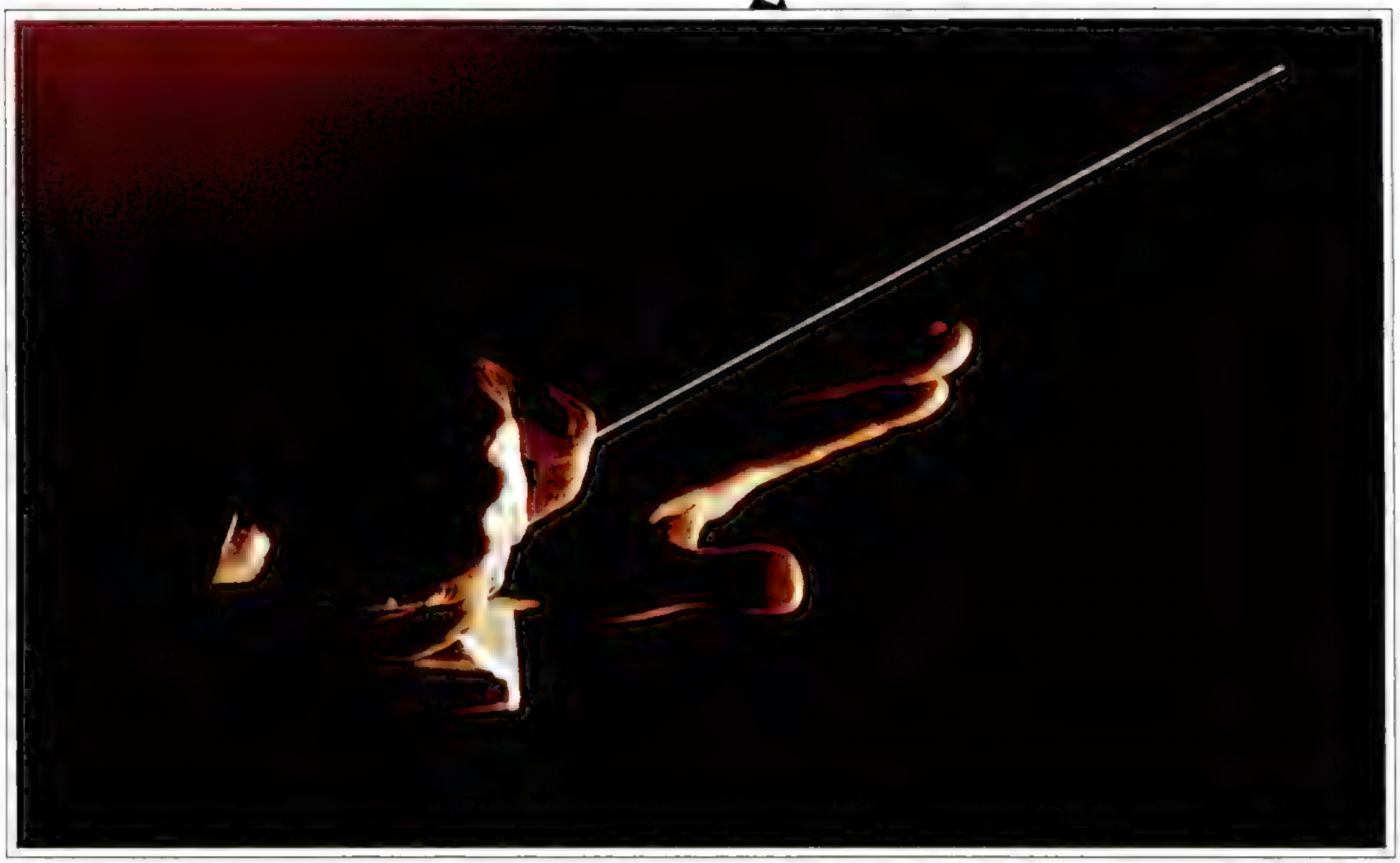

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FACT FILE

UM Galaxy 486VLB-33MM

United Micro, 5430 Jimmy Carter Blvd. #233, Norcross, GA 30093; 800-886-4833, 404-840-9250; fax, 404-840-9252

List price (tested configuration): $2,549

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Maxtor LXT 7213A 15-ms 213MB IDE hard disk with 64K cache, DTC 2270VL VESA local-bus hard disk controller card, 1.2MB and 1.44MB floppy disk drives

Display: Orchid Fahrenheit 1280° Plus VLB VESA local-bus card video controller with 1MB dynamic RAM, Addonics C152/LR 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, The Animals!, ChessMaster 3000, Mavis Beacon Teaches Typing, Grolier Multimedia Encyclopedia, Software Toolworks Atlas Pack

In short: Low-quality sound and poor benchmark test results make the UM Galaxy 486VLB-33MM a disappointment

483 ON READER SERVICE CARD

drive and the Aztech Labs Sound Galaxy NX Pro sound board proved to be a poor combination in the Galaxy. CD-ROM tests showed roughly average throughput—United Micro offers the Galaxy with a Sony double-speed drive for an extra $275. Overall sound quality was judged poor, with severe high-frequency roll-off at 10 kHz in preamp tests. Such limitations to performance and quality relegate this system to playing spoken word.

The best performance scores achieved by the Galaxy were close to average, but none were above. Two of the poorer scores were on our disk and Graphics Winmark tests. The Galaxy was the fourth slowest in hard disk performance, turning in a score that was 55 percent below average. The Orchid Fahrenheit 1280° Plus VLB VESA local-bus video adapter turned in a disappointing score of 9.8 megapixels per second on our Graphics Winmark test, also well below this test group's average.

The Galaxy ships with a modest selection of the usual CD titles including the Multimedia Encyclopedia and ChessMaster 3000. The unit also came with a pair of Labtec CS-700 external speakers that cost an extra $39.

With poor performance and mediocre multimedia features, this unit falls short of users' expectations.—*SP*

Unitek Technology Inc.

UT-66VLM

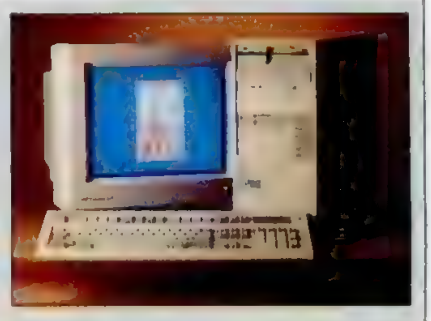
Priced at $2,750, the UT-66VLM offers a smart set of individual components that suffer from the system's poor memory speed. It is a reasonable choice for a multimedia PC.

The Unitek is a 486DX2/66-based unit in a mini-tower case. Three half-height and three 3.5-inch drive bays are accessible. The unit we tested had a 15-inch Optiquest monitor with 1,280-by-1,024 resolution and an Orchid Fahrenheit VLB video card with 2MB of memory.

Unlike so many units tested here, the Unitek provides a well-matched CD-ROM and sound board. Included is a Media Vision Pro AudioSpectrum 16, which yielded the best qualitative measurements on PC Labs' tests. The UT-66VLM's NEC CD-ROM performed about average on our throughput tests, delivering a strong enough signal not to cripple the sound card's capability. These components join to produce good, dependable sound. The highest-end CD-ROM drive that is offered with this system is the Toshiba XM-3401 (its speed, 200 milliseconds; its data transfer rate, 365K per second). This drive costs $40 less than the one included with our system. Unitek Technology's explanation is that NEC is a more recognized and trusted name than Toshiba.

UT-66VLM

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	FAIR
Multimedia	GOOD



FACT FILE

UT-66VLM

Unitek Technology Inc., 1917 S. Vineyard Ave., Ontario, CA 91761; 800-944-5650, 909-930-5700; fax, 909-930-5710

List price (tested configuration): $2,750.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache.

Disk drives and controller: Conner CP30254 13-ms 255MB IDE hard disk with 64K cache, Tyan IDE/VLB disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Orchid Fahrenheit VLB VESA local-bus card video controller with 2MB dynamic RAM, Optiquest 2000DX 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024.

Software: DOS 6.0; Microsoft Windows 3.1; Compton's MultiMedia Encyclopedia, Macromedia Action!; PFS Works for Windows; Where in the World is Carmen Sandiego?, Deluxe Edition

In short: The Unitek UT-66VLM showed slow memory performance on our tests. Its quality suite of multimedia components and software and its good sound quality are some consolation

484 ON READER SERVICE CARD

The one area in which the Unitek struggles is memory access, producing results at 30 percent below average on our memory tests and 15 percent below average on our Windows Applications suite. This may be due to the use of a little-known Micro Center Computer motherboard. The system board has one 8-bit and five 16-bit ISA slots, as well as two VL-Bus slots; 256K of external processor RAM cache is included, and there is a ZIF socket for the fan-cooled processor.

The Unitek came to us with some attractive CD titles like Action!, from Macromedia (presentation software), and Where in the World is Carmen

Sandiego?, Deluxe Edition. While not a stellar performer in all respects, the Unitek covers the multimedia basics well. A quality sound card and CD-ROM drive and good CD titles make this system worth considering.—*SP*

Vektron International Inc.

Vektron Business Multimedia

The Vektron Business Multimedia provides varying degrees of performance with an unusual combination of components. The 486DX/33 Vektron lists for $2,750, just making our price cutoff. Unfortunately, choppy performance and poor sound quality don't do much to justify the high price tag.

Vektron Business Multimedia

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	GOOD
Multimedia	POOR

The Vektron system uses a tower case, which provides room for six half-height devices. Not limiting certain bays to 3.5-inch devices means that the Vektron multimedia system has a little more flexibility than other units in this roundup. The ACIO motherboard provides access to one 8-bit, five 16-bit, and two VL-Bus slots.

Still, the overall quality of the sound card seems to be at the mercy of the CD-ROM drive with the Vektron. The Matsushita single-speed drive produces a relatively low-amplitude signal to the sound card, unneccessarily increasing total harmonic distortion. Vektron International also offers two optional CD-ROM drive upgrades: Texel's DM3024 and Toshiba's 3401. The sound card, the Creative Labs Sound Blaster 16, seems to be of decent quality, though it's hindered when paired with a low-output CD-ROM drive; hence, this unit's poor sound quality rating. A pair of fair-quality Soundblaster CT-38 speakers was sent with the unit.

The Vektron's performance was spotty, producing low memory scores but impressive disk results. The Vektron comes with a TekRAM VL-Bus caching IDE controller with 2MB of installed hardware cache RAM and a Maxtor 7345AT IDE drive.

FACT FILE

Vektron Business Multimedia
Vektron International Inc., 2100 Hwy 360, #1904, Grand Prairie, TX 75050; 800-725-0020, 214-606-0280; fax, 214-606-1278

List price (tested configuration): $2,750.
Memory and processor RAM cache: 8MB 60-ns SIMMs, 256K external cache.
Disk drives and controller: Maxtor 7345AT 14-ms 345MB IDE hard disk with 64K cache, TekRAM DC-680 VESA local-bus hard disk controller card with 2MB cache, 1.2MB and 1.44MB floppy disk drives.
Display: ATI Graphics Ultra Pro VESA local-bus card video controller with 1MB VRAM, CTX CMS-1561 15-inch monitor with a 60-Hz refresh rate at 800-by-600.
Software: DOS 6.0, Microsoft Windows 3.1, The Animals!, Groliers Multimedia Encyclopedia 1.0, Lemmings.
In short: The Vektron Business Multimedia, a relatively high-priced unit at $2,750, offers little to attract the multimedia user. Mixed benchmark test performance and questionable sound quality are decided drawbacks.
ON READER SERVICE CARD

The Maxtor provides more formatted capacity than most drives in this issue—345MB. On our DOSmark and Windows Applications tests, the Vektron came in about average for the pack. The graphic subsystem in the Vektron fared well in DOS but poorly in Windows. The ATI Ultra Pro VL-Bus video adapter, paired with the CTX 15-inch monitor, produced above-average scores on our VGA tests but 11 megapixels per second on our Graphics Winmark tests.

The Vektron lacks the consistent performance and quality required for demanding multimedia use. The Vektron also comes with a high price tag for a 486DX/33. Unless you need a full-size tower case, your money is probably better spent elsewhere.—*SP* □

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THE PRICE WATERHOUSE REPORT

LAN-Based Accounting At the Crossroads

by Ted Stevenson & Thomas White

These industrial-strength LAN-based packages handle volume and complexity.

The accounting business has sometimes been compared to the undertaking business: Both have steady, dependable markets since sooner or later everybody needs these services. But developers of LAN-based accounting products seem to be enjoying a period of considerable turbulence at this moment in history. When the *PC Magazine*/Price Waterhouse team last looked at multiuser, multimodule accounting software, a little more than two years ago, the big question was: Can LAN-based accounting capitalize on the trend of corporate downsizing? Today, the question is: How much of the turf heretofore ruled over by minicomputers and mainframes can PC-based accounting systems gobble up—and how quickly? A major scramble for shares of a new market is already well under way.

Until very recently, PC LAN-based accounting systems (multiuser systems based on file-server/workstation, not client/server, architectures) were relegated to the third tier of businesses large enough to employ professional bookkeepers and accountants—companies with gross revenues of $1 million to $50 million. (See the sidebar "Market Trinity: LAN-Based Accounting Strata" for more information.) They just didn't have

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Photograph by John Wilkes

the muscle to process efficiently the volume of data that flows through the accounting systems of larger firms. Accounting for larger businesses has been the exclusive territory of mini- and mainframe computers. All that is changing.

The traditional selling strategy for vendors of minicomputer-based systems—stressing functionality and performance over cost—is rapidly losing its punch in the marketplace. One reason is that the products represented in this roundup have clearly taken LAN-based accounting functionality to a new level. High-end features whose absence we noted as weaknesses in our last LAN roundup—robust multicurrency capabilities, landed cost, flexible 20-digit account numbers, sophisticated allocations, and the like—are realities in today's most powerful LAN packages. The features gap is steadily dwindling.

Further, PC Magazine Labs' rigorous performance testing for this story shows that today's best LAN-based systems can easily handle transaction volumes typical of companies that once formed the heart of the minicomputer market. Printing a detailed YTD General Ledger (G/L) listing of 105,000 transactions in less than 20 minutes (12 minutes 49 seconds, to be precise), as Macola's Macola Progression did in our tests, will satisfy even the most demanding accountant. The performance gap, too, has narrowed and has all but disappeared with reference to the heart—the middle and lower tiers—of the minicomputer accounting market.

SCORECARD

In this comparison, *PC Magazine* once again joined forces with Price Waterhouse to evaluate 11 top LAN-based multiuser accounting packages. By and large, these packages are U.S. market-share leaders (as determined by market-share data from Price Waterhouse); all have substantial support in the value-added reseller (VAR) community. Six of the packages—Computer Associates International's AccPac Plus, Great Plains Software's Great Plains Accounting, Macola, Platinum Software's Platinum (formerly The IBM Platinum Series from IBM Desktop Software), RealWorld Corp.'s RealWorld Accounting, and Solomon Software's Solomon III—were leaders in our last LAN accounting review (October 15, 1991). The remaining five are a mix of up-and-coming new products—Intellisoft's Accounting Vision/32 and Syspro Impact Software's Impact Award—and industry veterans—MICA Accounting Software's MICA IV, Open Systems' Open Systems Accounting, and SBT Accounting Systems' SBT Professional Series—that for a variety of reasons did not make it into our last story. State of the Art declined to submit its product, M.A.S. 90, for review.

TRENDS & INNOVATIONS

Several emerging trends we noted last time out have gained momentum. For example, in 1991 only three of the packages we reviewed used Novell's Btrieve record manager. This year, 7 of our 11 packages are built around Btrieve, and Solomon Software (one of the four exceptions) was scheduled to release a Btrieve-based version in September, too late to be tested for this roundup. (The results of past *PC Magazine* performance tests have proven Btrieve-based products to be the fastest performers on a network—particularly a network with heavy traffic. Another Btrieve advantage is that numerous robust reporting tools are available to access Btrieve data.)

We've also seen dramatic strides along the road to customizability, a key selling point especially for larger, more complex accounting systems. Though some vendors base their customization strategies on source-code availability, more vendors now offer comparatively easy-to-use tools for tailoring their systems to meet specific business needs. Solomon Software's recently released SolomoNotes, for example, is a nonprogrammer's tool for adding data-entry screens and lookup windows to Solomon. With it, you might create a data entry screen for personnel information such as date hired, date of last review, benefits, previous employment, and evaluations, and attach it to the employee

Market Trinity: *LAN-Based Accounting Strata*

The high-end accounting software market breaks down into three broad segments based upon company size.

THE TOP TIER serves the 1,000 largest multinational corporations, which traditionally have used mainframe-based software systems such as Dunn and Bradstreet and SAP. These products offer extremely high levels of functionality, run on a client/server platform, and are typically sold and implemented directly by the vendor. Companies in this group should expect software costs to range from $300,000 to over a million dollars for a full set of accounting modules.

THE SECOND TIER serves middle- to large-size companies (roughly $50 million to $500 million in gross revenues) that traditionally used minicomputer-based systems. Second-tier PC-based software has strong functionality; it may be sold directly or through resellers. These products typically offer client/server architecture either directly or indirectly (through ODBC, for example). Typical software investments in the second tier range from $30,000 to $300,000.

THE THIRD TIER (basically, the products reviewed in this issue) targets small- to medium-size businesses with revenues of $1 million to $50 million. It is typically file-server-based. These packages, sold almost exclusively through resellers, are supported and implemented by authorized consultants. Software costs (as distinct from support and other consulting costs) tend to be below $30,000.

master record in the Payroll module. Then any time you call up the employee record, you could jump to a secondary screen to view the personnel information.

Impact Award takes a different approach, offering a multitude of options in the setup procedure that can dramatically change the way the system operates. The inventory module alone has six screens of setup options. A macro facility, like the one found in AccPac Plus, can be used to tailor a system to specific business needs. With macros you can not only automate standard procedures like month-end tasks but also create new menus or enter default values in data entry screens.

Raw power continues to spiral as well, with Platinum's new Premier Ledger providing the most notable upward surge (not only in features but, at $10,000, in price as well). Premier offers segmentable, 32-digit account numbers, unlimited budgets, and an outstanding financial report writer, FRx. Platinum's Foreign Currency & Consolidation add-ons and AccPac Plus's standard G/L provide full FASB-52 compliant multicurrency consolidations for companies with foreign subsidiaries. Macola's product configurator allows manufacturers to "build" products on-line during the order process, an outstanding feature for products with multiple assembly options (personal computers are a good example). Impact Award will track the shipping and tariff costs (commonly called landed costs) of goods received from foreign suppliers, and even maintain route information.

MOVING TO LAN LAND

What will the brave new world of LAN-based accounting look and feel like for businesses moving down from host-based systems? What should these companies be prepared to give up? As noted, LAN performance should pose no unpleasant surprises—quite the contrary. The features gap, though diminishing, still exists, with the most significant discrepancies in multiuser support and system security. For example, most LAN-based systems are unable to restrict users from viewing and/or posting to specific departments or account segments. Nor do they provide

PC MAGAZINE

EDITORS' CHOICE

- **Accounting Vision/32 (for Windows shops)**
- **Macola Progression (for distributors and assemblers)**
- **Platinum (for large organizations)**

It came as something of a surprise that out of 11 reviewed products, 3 proved worthy of Editors' Choice designations, each excelling in a different area. Platinum with Premier Ledger provides the leading financial solution; Macola's inventory and order management capabilities are outstanding; and the Windows-based Accounting Vision/32 stands out for its G/L and overall flexibility.

Platinum's Premier Ledger offers minicomputer functionality (at near-minicomputer prices) with its excellent multicurrency, consolidation, and flexible 32-digit account number. The basic price of Premier Ledger is $10,000, with Foreign Currency, Consolidations, and Intercompany Processing available for an additional $10,000. While Premier is significantly more expensive than the other packages reviewed, many larger companies downsizing require this level of sophistication. Flexible reporting and excellent network performance are also trademarks of this package.

Macola continues its tradition of strong distribution modules (Order Entry, Inventory, and Purchase Order) and blazing network performance. It has added to its strength by including a product-configuration tool and enhancing physical inventory processing. While its financial modules are no slouches, most users gravitate to this system because of its ability to meet a business's operational needs.

Intellisoft's AccountingVision/32, the only Windows-based product reviewed, is a relative newcomer. While its GUI interface offers some unique capabilities, we were pleasantly surprised by how this package stood up when measured on accounting features. Some of it's features are unique: on-line budget verification during transaction entry, intercompany postings, and the ability to restrict posting by account segment by user. Add to that some of the things it can do thanks to its Windows interface—such as a WYSIWYG reports, DDE links to Excel, and modifiable screens—and you've got quite a solution.

Several other systems deserve honorable mention. Great Plains Accounting is the best-rounded package. While it may not match the strengths of the leaders, it has few glaring weaknesses. Its reputation for outstanding support and customer relations leads the industry.

Solomon Software's Solomon III has always offered good accounting features and strong accounting controls, but it has always fallen short on customizability. With the introduction of SolomoNotes, it has gained one of the most powerful and flexible customization and enhancement tools available that doesn't require a programmer.

Syspro Impact offers tremendous functionality for distributors and manufacturers. Its ability to handle landed costs, contract pricing, cost by location, and multiple-bin locations should attract the notice of companies with heavy-duty inventory-management needs.

SBT has significantly improved its Professional Series since we last saw it. The most notable improvements appear in the General Ledger and Inventory modules. These include larger account numbers, powerful account and item inquiry, flexible budgeting, and unlimited history retention.

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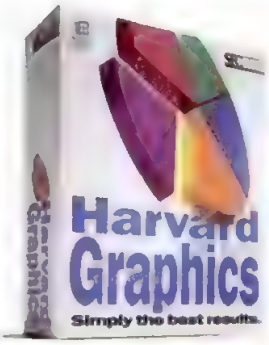

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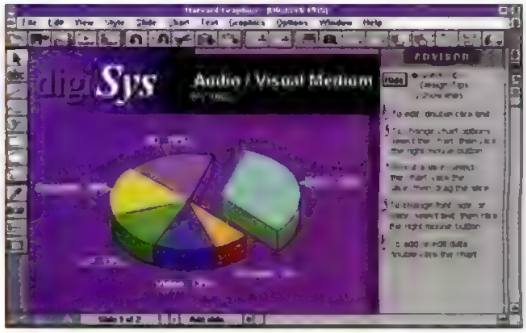

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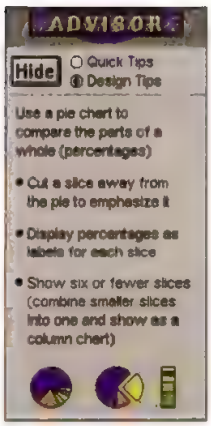

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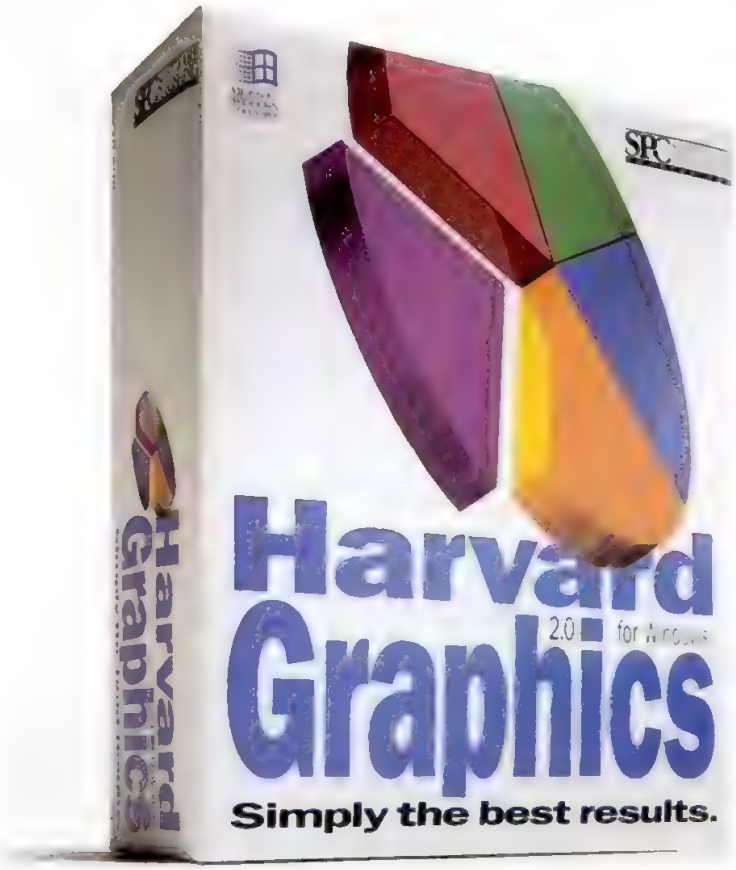

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Suitability To Task: LAN-Based Accounting

We chose six categories in which to evaluate the 11 accounting software products in this roundup. Because invividual business needs vary so widely, we chose not to assign weights to each category or assume one was more important than the other. In addition to depth of features, we also factored ease of use into the Suitability to Task scores. Key ease-of-use factors included the product's learning curve, overall ease of operation, on-line help, user documentation, and vendor support.

Under **financial accounting**, we looked at the features and functionality found in the General Ledger, Accounts Payable, and Accounts Receivable modules. For each package, we evaluated nearly 200 features such as chart of account flexibility, budgeting, allocations, on-line inquiry, history retention, payment selection, bank reconciliation, billing, and cash receipts. We also evaluated, where available, multicurrency, consolidations, and multicompany processing.

SUITABILITY TO TASK

Product Name

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	○	○	○
Managing orders and inventory	●	●	○	○
Reporting	●	●	●	○
Customization and implementation	●	●	●	●
Auditing and securing data	●	●	●	●

Software that effectively supports a business's operational needs can have a tremendous impact on productivity and efficiency. Under **managing orders and inventory**, we evaluated the abilities of the Order Entry, Inventory, and Purchase Order modules. Our major focus was on how well the system supported the day-to-day management of orders and inventory. We evaluated each package on its ability to address the 300 or more key features we were looking for.

Because of its importance, we evaluated **reporting** as a separate category. We considered four types of reporting: standard reports, financial reporting, systemwide report writers, and on-line inquiry. We ignored third-party reporting tools, concentrating instead only on those products sold directly by the software vendor. We examined the capabilities and flexibility of each.

It is virtually impossible to find an integrated accounting system that meets the needs of every business. What most businesses hope for is an 80 to 90 percent fit. The ability of a software package to be tailored or customized to meet or exceed that percentage is what we considered under **customization and implementation**. The most common ways of accomplishing such customization are source code modification, the ability to tailor a system during setup, and the use of third-party enhancements.

Under **auditing and securing data**, we considered the manner in which these systems protect data and maintain its integrity. We looked at the completeness of the packages' audit trail, system security, and fault tolerance. Additionally, we put each program through a series of in-depth performance tests (see the separate discussion of test results for more information).

adequate segregation of batches by user, so that individuals can view and/or post only their batches. And host-based systems typically do a better job of time- and user-stamping transactions for audit-trail and security purposes. Vendors of LAN-based systems will have to address these issues if they are to make deep inroads in the minicomputer market.

Further, many host-based systems provide specialty modules and functions not typically offered by LAN-based vendors. An important example is so-called project accounting—that is, the ability to track costs for items like a special R & D effort or a trade show. It's true that many LAN systems offer job-cost modules, but these are geared to the construction industry, not project accounting. Other specialized modules include human resource systems, full intercompany processing, and governmental accounting. LAN-based packages may offer such items as third-party add-ons, but few sell and support these directly.

Companies moving *up* to full-blown LAN-based accounting from an entry-level all-in-one or smaller-scale modular package will naturally find stronger accounting features, more flexible and plentiful standard reports, more powerful report writers and customization tools, and stronger multiuser capabilities. They should, however, be prepared to face the substantially greater complexity of implementing such a system. LAN-based accounting is definitely not a plug-and-play proposition. It requires much planning and assistance from consultants and VARs. The good news is these products have a large support base and formal support plans.

Accounting software vendors are currently locked in a development war more intense than any we've seen to date.

EMBARRASSMENT OF CHOICES

Just to add complexity to an already complicated situation, accounting software vendors are currently locked in a development war more intense than any we've seen to date. Virtually every major competitor in this once-conservative business is feverishly developing at least one revolutionary "next generation" product. (See the sidebar "Bean Counters for the Future" for more information.)

What does this mean for customers? The good news is that this technological ferment will ultimately produce powerful, innovative new business software—far beyond what's likely to be produced by the further evolutionary development of existing technology. The bad news is that, for the moment, exaggerated promises and overblown expectations are rampant.

What's driving this unprecedented flurry of development? Beyond the lure of the lucrative minicomputer market, the key force is the maturation of new tools—most important, graphical computing environments like Windows and OS/2 and client/server database technology—that are extending the PC's reach.

OPENING TO WINDOWS

Two years ago, accounting software developers were saying "Windows? Why

should we move to Windows? Our customers aren't interested: They're numbers people, and they don't care about a pretty interface." Today, they are stumbling over each other in their rush to get to market with a Windows product before the competition. Only one, Accounting Vision/32, was complete and available for this review.

What GUI advantages have come to light? One thing is a standard interface, which reduces overall implementation time and cost by flattening the learning curve. More important, basic GUI functionality—the ability to modify data-entry screens, view multiple entries from different categories on a single screen, link to data in a spreadsheet, and create true WYSIWYG reports—turns out to be heady stuff for accountants.

Client/server database architectures greatly extend the PC's overall data handling abilities, potentially transforming traditional accounting data into one part of a total business information system. First, it offers far better data security and integrity, allowing you to define data integrity rules at the server level instead of the application level. In a client/server environment, you could, for example, set up a database-level rule that customers' orders not exceed their credit limits. Such a rule would then be enforceable even when you were adding transactions from another source (EDI, for example). In a LAN-based system, rules of this kind have to be built into the application. If you happen to be using a third- party tool to access or change data, there simply are no rules; anyone can do anything to the company data.

Second, the architecture is scalable: Most client/server databases can run on a variety of hardware platforms, some capable of supporting thousands of users.

The inevitable tradeoff for the increased power of client/server systems is proportionate complexity of setup and management. Large client/server installations require the services of a full-time administrator. That's a price (small in comparison with maintaining a mainframe or minicomputer system) many companies will be happy to pay.

Today, businesses that are searching for the perfect accounting system have even more choices than ever before—including a basic choice between mature, tried-and-true file-server-based character mode technology and new, more powerful, but as yet untested GUI technologies.

As guidepoints in the search for a system, read the reviews that follow, study the performance testing results, peruse the features highlights (and download the complete summary of features from *PC Magazine's* editorial forum on ZiffNet, Library 3: Type GO ZNT:EDITOR at any ZiffNet or CompuServe ! prompt; search on keyword *v12n18*), and last, but not least, read the sidebar "Bean Counters for the Future," our report on what's coming in the next wave.

FEATURES PLUS

We invite you to download the complete summary of features from *PC Magazine's* editorial forum on ZiffNet, Library 3: Type GO ZNT.EDITOR from any ZiffNet or CompuServe ! prompt, search on keyword v12n18.

Our Contributors: This evaluation is a result of a collaboration between *PC Magazine* and a team of accounting experts from Price Waterhouse. BERNARD PLAGMAN, project partner in Price Waterhouse's New York office, handled project coordination. The team leader, THOMAS WHITE, is a partner with Systems Advisory Services, a California-based consulting firm specializing in the implementation of accounting and manufacturing systems. Reviewers MICHAEL DIXON, LEE HILLS, W. WESLEY HOWARD III, AND EDWARD KNEITEL are senior managers at Price Waterhouse locations in the U.S. and Canada. CHUCK AMERONGEN, SUZANNE M. COLVIN, ANDREW DONDLINGER, LUCIANO MEROCCHI, MURTAZA MOHAMED-TAKI, and SANDRA SAPONARA are Price Waterhouse managers. ROBERT M. MACWHIRTER is a senior consultant for Price Waterhouse. KEN TAGGARD, a Price Waterhouse network specialist, provided technical guidance and assistance during the performance testing. TED STEVENSON was the associate editor in charge of this story, and BEN GOTTESMAN was the project leader.

Intellisoft Inc.

Accounting Vision/32

BY SANDRA SAPONARA

Intellisoft's Accounting Vision/32, Version 1.207, was the surprise package of this issue. One of the first GUI-based high-end LAN accounting software packages on the market, Accounting Vision/32 provides an impressive combination of flexibility, high-end features, and customizability. It's easy to alter screens, create word processor–quality financial reports, and interface with other Windows products. Accounting Vision/32's 12 modules ($1,495/module for the five-user network version) are available for Windows and OS/2 (and eventually Windows NT) and will use either standard Btrieve or NetWare SQL data managers.

FINANCIAL ACCOUNTING

The standard General Ledger (G/L) includes a 12-digit account code, but Intellisoft also offers a 25-digit version ($2,995) and a 50-digit version ($5,995). All versions allow user-defined segmentation and up to 10 user-definable statistical fields. Larger companies with complex account code structures will find the ability to restrict a user from posting to a specific account segment a useful way to curb posting errors. For such an otherwise sophisticated product, there is surprisingly little on-line account analysis.

The Fund Accounting module includes a level of features not found in any of the other packages reviewed here. An intercompany transaction only needs to be entered once. The offsetting intercompany transaction is automatically created for the other company in the same batch. One interesting, and useful, control feature is the ability to restrict posting to an account if the balance is over the original or revised budget amount. Budget verification is available while processing Accounts Payable (A/P) invoices on a monthly or year-to-date basis.

You can also use a different currency for each company and test currency translations before posting the transactions. But Accounting Vision/32 is not a true multicurrency system. It does not allow transactions to be booked in multi-

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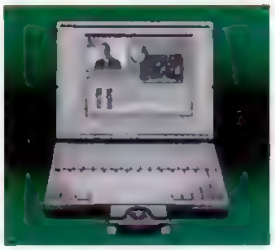

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- 1 PCMCIA slot (Type 2)
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currencies, nor is it in full compliance with FASB 52. Intellisoft representatives told us they're developing a full multicurrency system with multilanguage options that will ship by the end of the year.

A disappointment in A/P is the fact that recurring invoices are not fully automatic. A batch will be created, but the user must manually post it. On the up side, 1099 forms can be submitted in printed, magnetic, or EDI form just by clicking on the preferred button.

ORDER MANAGEMENT AND INVENTORY

In Sales Order and Accounts Receivable (A/R), invoices may be recurring and entered in batches or posted directly. If you've already set up freight tables (manually or electronically) used by freight companies, for example, you can automatically calculate freight costs based on the weight of the product and the customer's shipping address.

Unlimited user-defined payment schedules may be set up at the time of invoicing for contracts or for alternative payment methods such as cash or charge cards. A useful addition would be the ability to handle blanket orders.

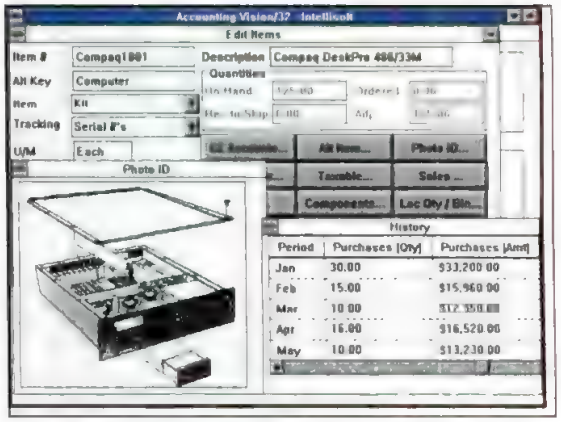
Businesses concerned that a GUI-based accounting system will slow down data entry should take a close look at Sales Order entry. Although you won't be able to eliminate the use of a mouse (there are keystroke equivalents for most functions, but not all), the screens can be tailored to streamline the order process.

If a customer's payment check bounces, the system will re-establish the receivable and (if the option is selected) will automatically charge the customer an NSF (Not Sufficient Funds) fee.

Accounting Vision/32 tracks an item's serial number or lot number, but not both for the same item. Mass item base prices and cost updates can be done by percentage or amount. You have the option of creating kits that relieve inventory at the time of order and display each component on the invoice, or you can set up a bill of material and assemble a finished good. The finished goods' components would be relieved from inventory at the time of assembly. All items can be tracked at an unlimited number of warehouses with item costs maintained by location.

Physical inventories could be better supported. You can print count worksheets, check physical inventory, and then post the difference. However, there is no support for cycle counts, nor can you freeze inventory.

One nice feature is the ability to assign a bitmapped image of the inventory item to the item record. Each time you call up that record, the inventory module will display the item's image.



Intellisoft's Accounting Vision/32 inventory item maintenance can include bitmapped images of the products for each inventory item.

REPORTING

Intellisoft offers filter buttons by system and by report classification so you don't have to scroll through its 200 pre-defined reports. Further, to access their most often used reports, users can create command buttons and place them on the main menu screen. Although most of the standard reports prompt you for some report parameters, you're often left wishing they asked for more. For example, the inventory transaction report does not prompt you for a warehouse ID.

The powerful built-in report writer can access every module (not just the G/L), every file, and every field. Although it's a capable general report writer (all of the standard reports were written with it), using it requires decent database skills and some patience.

CUSTOMIZATION

The data manager module allows all data files and fields to be imported and exported to and from other applications. You may also export data as a Microsoft Excel file using Dynamic Data Exchange (DDE). You cannot export data in any other Windows application file format. Third-party tools (such as Microsoft Access or Visual Basic, and Borland's ObjectVision, Paradox, or dBase) can be used to link unique appli-

SUITABILITY TO TASK

Accounting Vision/32

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	●
Managing orders and inventory	●	●	●	○
Reporting	●	●	●	●
Customization and implementation	●	●	●	●
Auditing and securing data	●	●	●	○

EDITORS' CHOICE

FACT FILE

Accounting Vision/32, Version, 1.207

Intellisoft Inc., 2114 West Mayfield, Arlington, TX 76015; 817-467-7243, 800-933-4889; fax, 817-467-7133

List price: $995 per module; 2- to 5-user module (Btrieve), $1,495; additional users over 5, $395 each; NetWare SQL, $2,995; G/L account expansion to 25 characters, $2,995; G/L account expansion to 50 characters, $5,995. Upgrade fee is the difference in price between the old and new versions (if any) plus a handling fee of $15 per module.

Requires: Server: 20MB hard disk space, 8MB-16MB RAM, NetWare, any NetBIOS compatible system. Workstation: 8MB RAM, Windows 3.1 or higher, OS/2 2.0 or higher, Windows NT. EGA or VGA. Mouse recommended.

In short: This GUI-based accounting software offers user-customizable reports, forms, windows, and desktop, in addtion to some wonderful high-end features. Accounting Vision/32 is a young product without the support base of some others reviewed here, but it's worth considering if you're thinking of moving to a GUI-based product.

ON READER SERVICE CARD

cations to any Accounting Vision/32 module.

The product also includes a Vertical Market Toolkit (included in the System Manager module). This nifty tool allows complete customization of all reports, entry screens, and the desktop. With it, you can add bitmapped images to a user's desktop; hide an input function; change the entry screen, prompts, and window titles; or create functions as buttons on the desktop.

AUDITING AND IMPLEMENTATION

Optional password protection may be used to control access to specific windows, files, and reports by user and by company.

Since so much of the system is user-definable or customizable, system implementation requires a good deal of planning. Because Accounting Vision/32 is a young product, the support base of resellers and consultants doesn't match that of the more mature products reviewed here.

Not surprisingly, this Windows product requires a greater hardware investment than the other character-based products reviewed here. Users should have a minimum of 8MB of RAM, a 386 PC (although a high-end 486 PC would be recommended) and, of course, Microsoft Windows or OS/2.

Amazing as it may seem, this first-generation product has made it to the top ranks of this multiuser accounting software roundup. Its impressive power and incredible customizability should lay to rest any lingering doubts about the suitability of the Windows environment for accounting.

Computer Associates International Inc.

AccPac Plus

BY MURTAZA MOHAMED-TAKI

AccPac Plus, one of the original accounting software competitors in the PC marketplace, continues to be well suited for midsize businesses. With the release of Version 6.1 (most modules retail for $795), Computer Associates International has strengthened its longstanding reputation for producing quality financial applications with solid accounting functionality and strong import/export capabilities.

SUITABILITY TO TASK

AccPac Plus

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	○
Managing orders and inventory	●	●	○	○
Reporting	●	●	○	○
Customization and implementation	●	●	○	○
Auditing and securing data	●	●	●	○

FINANCIAL ACCOUNTING

The most dramatic enhancement in Version 6.1 is the multicurrency capability in its financial accounting modules The system allows you to define unlimited currencies and exchange rates that can be updated at will. Transactions can be entered, retrieved, and posted in home and source currencies throughout the core modules. The multicurrency versions of Order Entry, Inventory Control, and Purchase Order are slated for release later this year; upgrades are free to 6.1 users.

In the G/L, each multicurrency account maintains the current year, prior year, budget, and historical information in all currencies assigned to that account. The system fully manages the tracking and recording of exchange gains and losses based on a revaluation code, and the type of exchange rate to be used for calculating the current home currency. Gains or losses from the revaluation will be posted to a user-defined G/L account.

The G/L account structure consists of two fixed segments of six characters each. Accounts can be made inactive at any time, and you can even specify whether an account will maintain detail or summary posting information. An account can also be reallocated to other accounts based on predefined percentages.

Financial statements can be produced in any currency; Computer Associates claims full compliance with GAAP and FASB 52 requirements.

PAC IT IN

AccPac Plus uses a batch data entry approach for all its modules. The G/L includes a provisional reporting feature that gives the user all the benefits of a real-time system while enjoying all the accounting controls of a batch system. Provisional financial statements are useful in reviewing potential results and in performing what-if scenarios.

The G/L, however, maintains only one year of historical information and allows only one current-year budget per account. It has an individual transaction limit of $999 million that can be limiting for larger companies.

The A/P and A/R modules allow nearly 70,000 vendor, customer, bank, and control accounts each. It would be helpful, however, if you could group related customers to speed up the cash receipts process or the printing of statements. Both the A/R and A/P modules provide handy detailed tax tracking and statistical reports. A new A/P feature lets you define any number of G/L accounts to which you may want to distribute the details of an invoice. A default set of accounts is defined for each vendor but can be replaced with any other set available from the table at the time of data entry.

ORDER MANAGEMENT AND INVENTORY

AccPac Plus offers useful inventory and order management modules. Inventory item numbers can have a maximum of 16

FACT FILE

AccPac Plus, Version 6.1

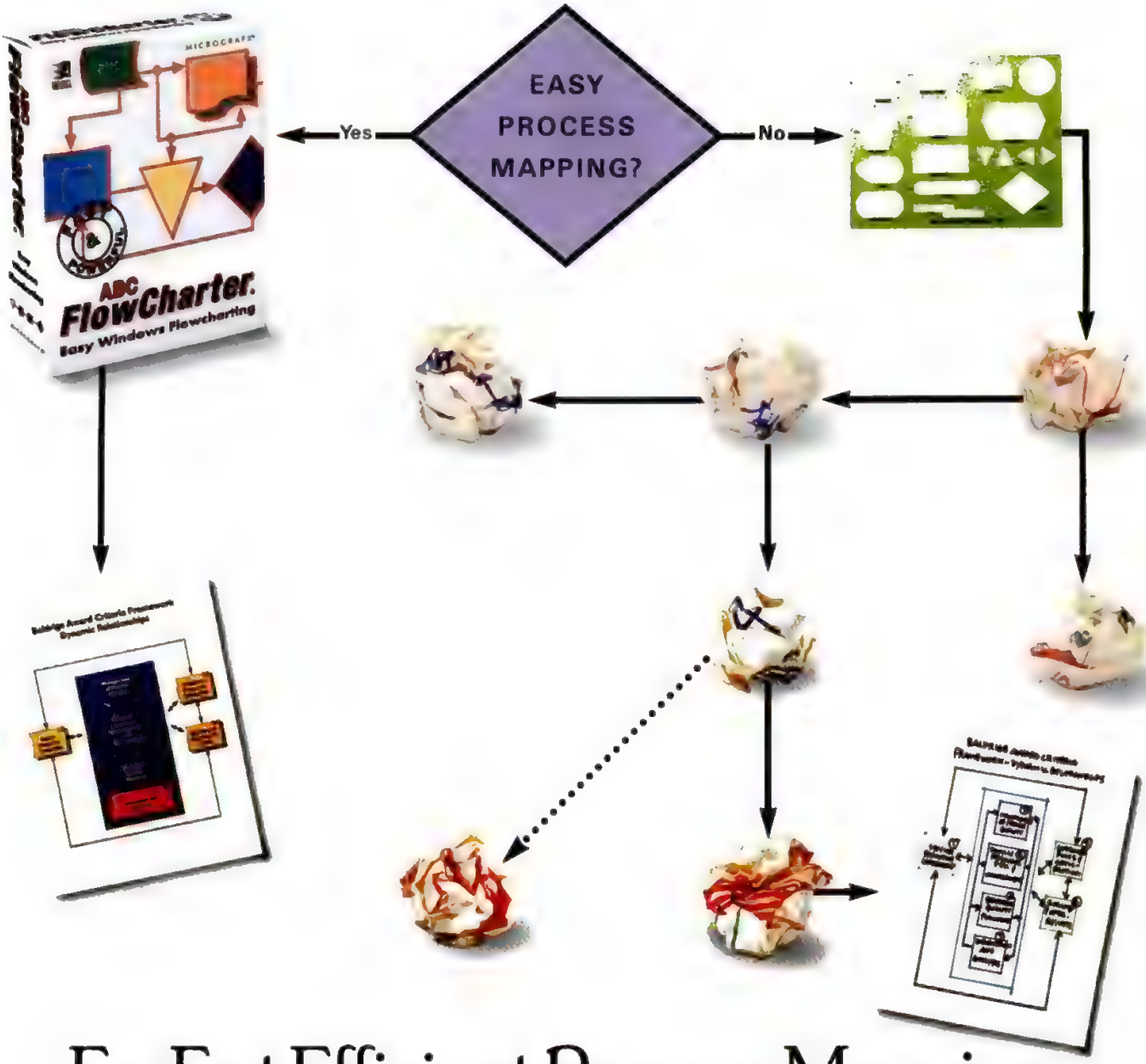
Computer Associates International Inc., 1 Computer Associates Plaza, Islandia, NY 11788-7000; 516-342-5224, 800-225-5224; fax, 516-342-5329

List price: $795 per module; 4-unit LanPack, $395

Requires: Server: 640K RAM, 19MB hard disk space, AccPac Plus Accounting LanPak. Workstation: 640K RAM, DOS 3.1 or later, AccPac Plus Windowing System Manager 6.1 or later.

In short: AccPac Plus is a well-rounded financial accounting package offering solid accounting functionality and strong import/export capabilites. However, if you're looking for a package that can handle the most complex accounting tasks, it may not be for you.

494 ON READER SERVICE CARD



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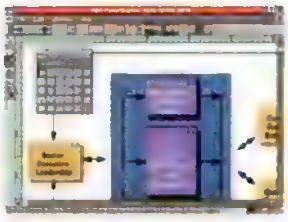

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CIRCLE 361 ON READER SERVICE CARD

Bean Counters for the Future

by Thomas White

There's a virtual blizzard of product development underway in the LAN-based accounting industry as vendors scramble for their share of the mini-computer accounting market; many of the vendors included in this review are key players.

Platinum Software Corp.'s SeQueL to Platinum is the first product from a traditional LAN-based software company targeted for large, multi-national corporations. Much of its success can be attributed to its state-of-the-art technology. A fully client/server product, it uses the Sybase SQL Server database engine and runs under OS/2, Windows, and Windows NT. When Platinum began development, only limited tools were available to support client/server, so the company wrote its own tool set. Expect to pay $50,000 to $150,000 per module plus significant implementation fees.

With its multicurrency capability and other advanced features, Platinum's Premier line is targeted at the low and middle tiers (see the sidebar "Market Trinity: LAN-Based Accounting Strata"). The line consists of the Premier Ledger and Advanced Manufacturing modules; for other modules, you must use the standard Platinum units. Eventually, Platinum plans to fill out its Premier line with specialty modules like Human Resources, Treasury Management, and EDI; the series will not include standard A/P or A/R modules. Also, expect to see Windows versions of both Platinum Premier and standard Platinum roll out in 1994.

Great Plains Software also has a multitiered product strategy and plans to introduce products serving the largest to the smallest businesses. The top-of-the-line product, Corporate Dynamics, will be a SQL-based graphical system with a rich feature set. The G/L, A/P, and A/R modules are available now; the remaining core modules (Order Entry, Purchasing, and Inventory) will be rolled out by year's end. Corporate Dynamics SQL is priced from $25,000 to $100,000 per module.

Like all of Great Plains' new products, Corporate Dynamics is being developed using an internally created tool set called Dexterity. Dexterity applications have clean GUI interfaces and are interoperable with the Macintosh. Almost the same code is used with Windows and Macintosh workstations, which can access the same data files concurrently.

Great Plains' Corporate Dynamics is targeted to meet the needs of companies in the third tier. It is priced from $1,000 to $3,000 per module. While most of the modules—including G/L, A/R, and A/P—are available today, the remaining key modules are due out by the end of 1993. For the middle tier, Great Plains is developing an enhanced version of Dynamics, with advanced performance and a larger feature set. Expect to see this new item rolled out in the first quarter of 1994 with a cost of $5,000 per module.

Macola's development strategy consists of two primary products. The current Progression series has been enhanced to include multiple front-ends (DOS, OS/2 2.0, and Windows) while maintaining its existing COBOL-based application programs. Macola's new product line, the EnVision series, is written entirely in C++ and is targeted to middle tier. Initially, this product will use NetWare-based databases (Btrieve) using NetWare SQL, but long-term plans include migration to client/server databases. The G/L and Report Writer modules were scheduled for release in September of 1993; the A/R and A/P modules are scheduled for first quarter of 1994. The remaining modules (Order Entry, Purchasing, and Inventory) are scheduled for release later in 1994.

Solomon Software is making two major changes to its product offerings. First, Solomon III will have moved from the MDBS database to the more standard Btrieve data manager by September of 1993. Btrieve should provide greater speed and more openness than MDBS. Second, the company is releasing Solomon IV Windows, a completely new, GUI-based offering targeted at the middle tier. Written in Visual Basic, it will use NetWare SQL database services and include 20 modules. The first 11 modules were scheduled for release in September with the remaining modules to be released during the first and second quarters of 1994. Prices are expected to be between $1,000 and $7,000 per module, based upon the number of users.

Computer Associates will be releasing AccPac Plus for Windows by the end of 1993 and will include greater functionality than the DOS-based AccPac Plus product.

Open Systems is developing a new product line called Encompass, which will be written in Microsoft Access and will include source code. Its functionality will be similar to Open Systems Accounting software. It is expected to be released by the fall of 1994.

SBT recently released a Windows version of its SBT Professional Series, which shipped too late to be included in our review, and **Syspro Impact Software** plans to release a GUI version of its Impact Award series in mid-1994.□

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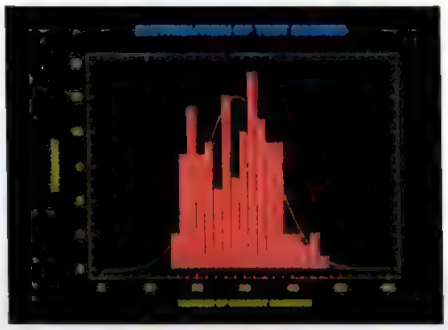

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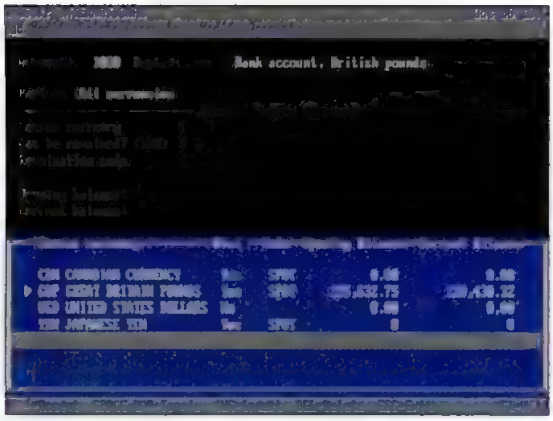

AccPac Plus's new multicurrency General Ledger transaction inquiry provides a quick look at the activity in an account.

alpha/numeric characters with a maximum of four segments. Extensive information, such as additional item data, can be kept per item for better inventory management. AccPac Plus also supports five inventory valuation methods—FIFO, LIFO, Moving Average, User-Specified, and Standard costing—and provides multiple location and stock transfer features.

A single-level bill of material is available for companies dealing with simple manufacturing, repackaging, and bundling. Additional fixed and variable costs can be entered during the assembly process. Purchasing transactions can be entered directly through IC or PO, as well as all movement transactions such as receiving and transfers.

You can define up to five markup or discount price levels by customer type or quantity purchased, and price levels may be set by amounts or percentages. A "special sale pricing" for a range of dates is also supported for each inventory item, and an estimated weight-per-order is computed for freight purposes during order entry.

The lack of some key features detracts from the overall capabilities of the inventory and order management modules. For example, AccPac Plus is unable to track inventory in lots (although a third-party add-on is available), and it doesn't provide any ABC analysis capabilities or track landed cost such as freight and duties. Neither can it split sales commissions, track item cost by location, or freeze inventory during the actual physical count.

REPORTING

Standard reporting is flexible but a little hard to use. The G/L includes a versatile financial statement report writer, but because it has its own programming language, you'll find the learning curve to be quite steep.

If you need better reporting capability, Computer Associates offers DynaView, an application that dynamically links data in AccPac Plus to a spreadsheet; transaction and master-file information from seven modules can be linked to either CA-SuperCalc or Lotus 1-2-3.

CUSTOMIZATION AND IMPLEMENTATION

Although source code is not available to users, Computer Associates provides the CA-Software Development Kit, which provides a full development environment including a compiler, editor, and forms manager. Several third-party add-on solutions that work in conjunction with AccPac Plus are also available and are listed in the directory of software solutions called the CA-Access Library. The solutions listed include manufacturing, medical, mortgage administration, and car dealerships. A more customizable Windows version of AccPac Plus is slated for release later this year.

AccPac Plus is one of the few programs reviewed here that allows users to alter the format of key forms, such as checks, statements, and invoices. The Windowing Systems Manager (WSM) allows you to perform data integrity checks and assign multiple printers. The built-in field-sensitive Smart Finder will find the closest possible match based on user-defined search criteria. The Macro Manager, which is part of WSM, provides high-end macro capabilities that can be used to tackle everything from automating redundant procedures to customizing menus.

AccPac's data security system is somewhat disappointing for a high-end accounting package. It requires users to log into the program using the password for High, Medium, or Low clearance. Although this approach may work for smaller businesses, many larger corporations require security to be defined by user and function.

AccPac's performance times were reasonable in our testing, but the program failed the fault tolerance tests due to its underlying file structure. The product actually corrupted data during one test. The Btrieve-based Windows version, soon to be released, should address this issue.

If you need a package that can handle the most complex accounting tasks, it's best to look elsewhere. But if you're looking for a well-rounded financial accounting system that includes multicurrency capabilities, and you don't have exceptionally sophisticated order entry and inventory requirements, then AccPac Plus is worth considering.

Great Plains Software Inc.

Great Plains Accounting

BY ROBERT M. MACWHIRTER

Great Plains Accounting, Version 7.0, from Great Plains Software offers a full range of accounting features. While the menus and data entry screens in this version remain functional—not fashionable—a number of enhancements improve the usability of the software. And the package is particularly well suited to multisite sales operations with centralized inventory purchasing and management.

SUITABILITY TO TASK

Great Plains Accounting

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	○
Managing orders and inventory	●	●	●	○
Reporting	●	●	●	●
Customization and implementation	●	●	●	○
Auditing and securing data	●	●	●	○

The release of Version 7.0 incorporates more than 100 new features, most of which are designed to enhance usability, reporting flexibility, or network performance. Great Plains Accounting is priced from $795 to $995 for most modules and is available on DOS-based networks. The newest Great Plains releases (both 7.0) for the Unix and Macintosh platforms are sched-

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CIRCLE 344 ON READER SERVICE CARD

FACT FILE

Great Plains Accounting, Version 7.0

Great Plains Software Inc., 1701 S.W. 38th St., Fargo, ND 58103; 800-456-0025; fax, 701-281-3700

List price: $795 to $995 for most modules.

Requires: Server: 45MB hard disk space, NetWare 286 Workstation: 640K RAM, DOS 3.3 or later or Windows 3.0 or later

In short: The new version of Great Plains Accounting offers over 100 new features designed to enhance usability, reporting flexibility and network performance. Currently the program is available only on DOS-based networks, but upcoming versions will support both Unix and Macintosh.

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uled by this fall.

Lookup windows are now accessed consistently throughout the system via a single, user-defined function key. Great Plains also streamlines the movement from menu to menu by providing an on-demand pop-up window that displays available menu choices. You simply select the one you'd like and Great Plains takes you directly there.

The customizable on-line help system is easily accessed from within the standard field level help screen. This feature can be used to document company-specific procedures. Furthermore, you can now attach notes to master file records—like customers, vendors, and items—and transaction records. This feature would be even nicer if there were some on-screen indication of existing notes. Notes attached to inventory items can also be printed on invoices.

FINANCIAL ACCOUNTING

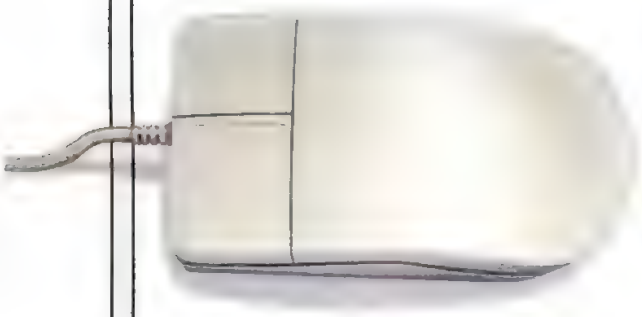
The G/L account number consists of 11 characters formatted in fixed-length segments for location, division, account, and subaccount number. You can tailor the format by removing all but the account segment. The G/L now supports multiple retained earnings accounts, allowing books to be closed by location, department, or both.

History and budgets can be maintained and accessed for unlimited numbers of prior and future years, and the system is able to generate new budgets based on existing budgets from a variety of user-defined criteria. Although the inquiry system included in the G/L is adequate, it does not include any drill-down capability to view information from a high level all the way down to the originating entry.

One of the most useful enhancements in Version 7.0 is the option to post by transaction date instead of system date. That is, you can now enter any date for any transaction, rather than necessarily having the date of the transaction default to the system date. This provides much greater flexibility.

The A/P and A/R modules are quite comprehensive, with many useful features, including complex tax computation and reporting (Value-Added Taxation, for example). A useful enhancement would be to allow default tax codes to to

Oh sure, they tell you they've got an accounting system that operates under Windows and has promising new functionality. But before you take the bait, take a closer look.



Some accounting tempt you with can be very

Find out if they truly offer a full Windows solution today. Or are they baiting you with a promise? Will it integrate with their DOS product? Is there an easy path to Windows? How much does it cost? Will you need retraining and new hardware? When will their product be available? A year from now? Two? Can you wait that long? Furthermore, have their systems been thoroughly tested?

Chances are, you'll discover the technology they're trying to lure you with has more holes than a hunk of Swiss cheese.

Truth is, only Macola Software brings you tomorrow's

Great Plains' data entry windows remain functional. Notes can be assigned to Customer, G/L account, Salesperson, or Job, and reviewed on-line.

be assigned to the ship-to address. Control accounts for G/L interfacing (Cash, A/P, and A/R) are defined at the vendor or customer level. In effect, that provides divisionalized posting of A/P and A/R transactions. However, agings cannot be produced by division.

Great Plains does not support multiple currencies. If you want bank reconciliation capabilities or require multiple checking accounts in A/P or A/R, you'll want to get the Cash Management module.

Commissions can now be split among as many as five salespeople, and can be calculated on sales or profit, based on rates from either the inventory item or from a salesperson table.

ORDER MANAGEMENT AND INVENTORY

Great Plains' support for multiple warehouse locations is substantially improved. You can now include items from multiple warehouses on one order, and print multiple pick lists. However, you still cannot track item cost or produce reorder reports by location. The Advanced Pricing feature allows contract-specific pricing by customer name or customer type.

Components, including serial components, can be assembled into final products using the Production entry. This feature allows the components to be assembled into finished items, and tracks the serial numbers of all sub-components. Serial numbers are tracked through the system with a history report available for warranty purposes. Great Plains does not track inventory lots.

The new Kitting feature permits items to be automatically pulled from inventory during order entry. When the quantity ordered exceeds the amount of inventory on-hand, you can choose to override, backorder, cancel, substitute remaining quantity, or substitute all. Substitutions can be made from a list of alternative items.

Support for physical inventory counts includes the ability to freeze inventory at the time physical count tags are produced. All told, Great Plains does a good job of tracking and reporting unused or incomplete tags.

Point-of-sale functionality is bundled with the standard Order Entry module. It's a nice plus for businesses with basic point-of-sale needs.

accounting technology today. It's called the *Progression Series*. And it's the *only* software that offers you a safe, budget-conscious path to the emerging technology of Windows. Even more remarkable, Macola's *Progression Series* lets you run DOS, Windows and OS/2 platforms at the same time. That's true interoperability. Risk-free! If you'd like more information to nibble on, give us a call. We'll send you a *FREE* White Paper entitled, *"The Past, Present and Future of Multi-User Accounting Software."*

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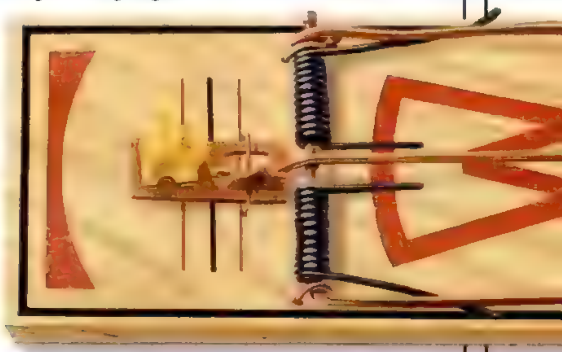

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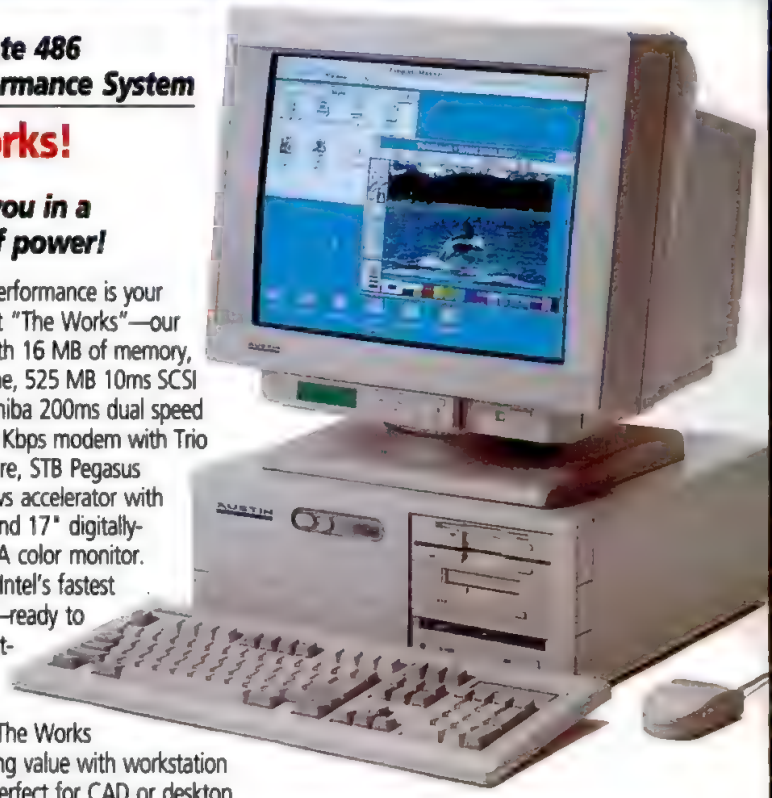

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CIRCLE 012 ON READER SERVICE CARD

Benchmark Tests: LAN-Based Accounting Software

In the two years since we reviewed them, LAN-based accounting packages have picked up a lot of speed. Today's top-performing systems can give minicomputer accounting packages a run for their money. The slower ones still have a long way to go before they threaten to encroach on host-based systems.

What the Numbers Mean

The results of the performance tests reflect two factors: the efficiency of the application software and the speed of the data manager. As we have found in the past, packages using Novell's Btrieve data manager (7 of the 11 we tested) tended to outperform the others. Indeed, the top finisher in each test was Btrieve-based. But using Btrieve doesn't guarantee top performance. MICA IV finished near the bottom in most tests; Accounting Vision/32 had the second slowest report and posting times.

The speed of the top packages was impressive. Platinum processed a detailed Aged Receivables report—one of the many reports in our Reporting test—that included 60,000 items and 8,000 customers in just 20 minutes. Macola produced a detailed, year-to-date G/L listing that included 105,000 transactions in less than 13 minutes. Programs performing like this can certainly hold their own against computer systems costing many times as much.

PC Magazine Labs' tests should give you a clear idea of which packages are fastest, but there's more to accounting systems than speed. Businesses must weigh all factors in selecting a package, including functionality, scalability, and support.

In the **Standalone and Concurrent Reporting** tests, we printed reports that would normally be used for a quick check-up on a company's financial condition. The Standalone vs. Concurrent Reporting graph shows the cumulative time to print all of the reports below.

The stock status report assumed that all 20,000 inventory items were maintained in one warehouse and that each item was listed with its part number, description, in-stock and on-order quantities, price, and extended value.

The A/R Aging report aged 60,000 detail transactions to 8,000 customers in a 30-, 60-, 90- and over-90-day aging scheme.

The A/P Aging report aged 26,000 detail transactions to 3,000 vendors in a 30-, 60-, 90- and over-90-day aging scheme.

The G/L Detailed Trial Balance listed each of the 105,000 G/L transactions by the 6,489 accounts.

The A/R Customer List printed master file information by customer number for each of the 8,000 customers.

The A/P Vendor List printed master file information by vendor number for each of the 3,000 vendors.

The G/L Summary Trial Balance printed the balance of the 6,489 accounts

Great Plains, Macola, and Platinum, all Btrieve-based packages, had the fastest times for both the standalone and concurrent tests. Open Systems labored through the reporting tests, which the company attributed to inefficient indexing routines. Accounting Vision/32, which had the second worst elapsed times, had the least degradation when measuring the standalone versus concurrent times.

Solomon's and Open Systems' A/R Aging and Stock Status reports did not allow for page numbers greater than 999. We compensated by printing a substitute aging report and printing three separate Stock Status reports, each printing a third of the inventory items.

In the Order Entry tests, we measured the time it took to enter orders into the system with one user, and with 5 and then 10 concurrent users. We took the average time of the 5-user and 10-user tests and charted each with the single-user test.

Platinum and Macola, the two best performers in our previous roundup, again took top honors. The FoxPro-based SBT finished third. MICA and Open Systems suffered from contention problems on the 5- and 10-user tests and finished significantly behind the others.

With Accounting Vision/32, the only GUI-based product, the single-workstation time was more than double that of Platinum, the fastest program in single-user order entry. But Accounting Vision/32's average 10-workstation time was only 1 second behind Platinum's, and only 5 seconds slower than the fastest time recorded (Macola). In fact, the product's average 10-workstation time was better than its average 5-workstation time. The minimal degradation is due to both one positive attribute (excellent caching) and one negative (the delaying of inventory committed field updates until the order is posted—the others do it right away).

Solomon posted a quick time in the one-user test, but its performance was substantially degraded in the 5- and 10-user tests because of a bug in the program. When Solomon is set up with a default warehouse in a single warehouse configuration, the program executes some additional but unnecessary lines of code. If no default warehouse is specified, the user will likely see performance much more in line with the top programs in this test. Solomon acknowledges the bug and will be fixing it in its next release, which should be available by the time you read this.

The **Total Posting Time** tests measured the processing time required to post the orders created in the Order Entry tests through to the G/L and the time to post 154 A/P vouchers through to the G/L. The steps we timed included printing of invoices and checks; posting

to A/R, Inventory, and A/P files; and posting to the G/L in detail.

The Financial Reporting test consisted of printing a one-column detailed Balance Sheet and a year-to-date Income Statement with three columns. Two columns listed specific department figures; the third included figures for the entire company. Accounting Vision/32, AccPac Plus, Great Plains, MICA, and RealWorld could not print the Income Statement with departmental columns, so we recorded the time required to print three separate reports. (Price Waterhouse does not validate the integrity of the financial statements that these systems provided).

The **Concurrency Tests** were untimed tests that examined the packages' locking and concurrency controls. For larger companies with high levels of activity, an ill-conceived locking scheme can be a major inconvience..

In our first concurrency test, we looked at how the packages handled updates of master file records: Two users attempted simultaneously to access and modify the same customer record. Most systems allowed only one user to access the customer record in update mode. The second user received an error message stating that the record was in use. That's an adequate approach, but more packages should follow the lead of AccPac and SBT in displaying *who* had the record locked.

Platinum and MICA use another approach to record locking. They allow multiple users to access the same customer record, but the first person to save gets his or her changes recorded. When other users try to save, a message informs them that another user has changed the customer record, forcing them to re-inquire and re-enter their changes. Accounting Vision/32 had a similar approach, except that when the second user attempts to save, her or she is given the option of overwriting the first users' changes. Finally, RealWorld provides true field-level locking by allowing two or more users to update different fields on the same record simultaneously.

We also looked at concurrency during postings. Some, like AccPac and Solomon, locked all affected files during posting, causing potential scheduling problems for larger companies. Others that allow access to masterfile records during posting will automatically poll the locked record until it becomes free. Ideally, the software would display who had the locked record—and the record itself—while continuing to poll.

Besides its normal posting process, Great Plains offers a master post, a single-user process intended to be run at night, that posts all of the open modules in any application through to the G/L.

The Fault Tolerance test, also known as the "Oh No" test, examined how the packages responded when a workstation or network became inoperable—turned off or disconnected—during the middle of a posting. Most of the packages did poorly; only four—Great Plains, Macola, Open Systems, and Solomon—passed with flying colors. To successfully maintain data integrity during system interruptions, the software must monitor processing to ensure that every transaction fully completes; that's called transaction tracking. Otherwise, the software needs to be able to roll back to its original state. Macola and Great Plains use the transaction tracking capabilities of Btrieve; Open Systems and Solomon rely on their own software and data managers.

Transaction tracking requires some overhead, which varies dramatically based on network load. Most vendors estimate that transaction tracking can cause degradation of anywhere from 10 to 40 percent. The speed portion of our performance tests did not require that the vendor have transaction tracking on, so because Open Systems and Solomon have no facility to turn transaction tracking off, they labored through our performance tests.

Open Systems and Solomon reacted similarly during our tests. Both immediately displayed a message that the post was halted unexpectedly and both prompted us to continue from that point. Macola and Great Plains did not notify the user until he returned to the posting screen.

While SBT can't match the fault tolerance of those four, it does provide a facility to identify and resolve data-integrity problems. Its Recalc function will scour data files for inconsistencies. For example, it will review the open invoices to ensure that they match the balance in the customer file. If they don't, you can have the system automatically update the customer file balance.

The other products failed our fault tolerance test. Users are left with the option of reconciling the data files to determine what has and hasn't posted or restoring from a backup and reposting.

How We Tested

Businesses eyeing the move from mainframe or minicomputer accounting to LAN-based systems have two major concerns. The first, whether the software meets accounting requirements, is assessed in our suitability to task testing. The second is whether the software can handle the heaviest transaction loads and provide adequate safeguards to maintain data integrity. For these issues, we conducted performance tests to measure each package's ability to process large volumes of transactions and fault tolerance tests to see how each handled power interuptions.

The tests were similar to those conducted in past reviews, but we used significantly larger data files. Each package was required to process 8,000 customers, 3,000 vendors, 6,500 G/L accounts, 60,000 A/R detail items, 26,000 A/P detail items, 105,000 G/L transactions and 20,000 inventory items.

Our test configuration consisted of 10 Compaq Deskpro 486/33Ms with 8MB of RAM and a 340MB disk and a Compaq Deskpro 486/33M with 16MB of RAM and a 450MB disk as the file server. We used Proteon's p1990 PRONET 4/16 EISA cards on our 16Mb Token Ring LAN. The network operating system was Novell's Netware 3.11 and the workstations ran DOS 6.0. Btrieve 5.15 was provided.

Vendors were invited to the Labs for the tests and were free to optimize the network as they saw fit, but no additional hardware or software could be

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added to the network, and RAM drives were not allowed on the workstations.

We used four performance tests, each simulating a common accounting task. The first, **Order Entry Degradation**, simulated the process of entering orders. The vendors created keyboard macros to enter orders on one workstation and then on five and ten workstations concurrently.

The **Total Posting Time** test measured the total required time to process invoices and checks respectively and post them to the G/L in detail.

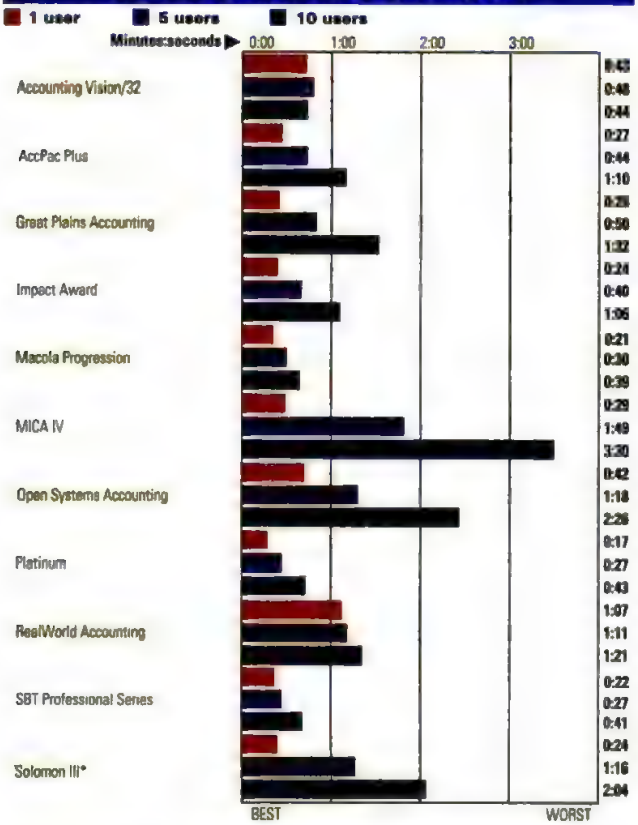
For the **Financial Reporting** test, vendors were required to print a detailed Balance Sheet and a year-to-date, multicolumn Income Statement. Reports were printed to spool files to prevent printer performance from affecting times.

Our **Standalone vs. Concurrent Printing** test measured the time required to print seven reports—Inventory Stock Status, A/R Aging, A/P Aging, A/R Customer List, A/P Vendor List, G/L Detailed Trial Balance, and G/L Summary Trial Balance—one at a time. Next, we printed the same seven reports concurrently.

In addition, we conducted several untimed tests to measure the multi-user concurrency and fault tolerance capabilities of each package. We examined multiuser concurrency by testing such instances as two users attempting simultaneously to modify the same customer record, and attempting to add or change customer records during posting of Accounts Receivable invoices.

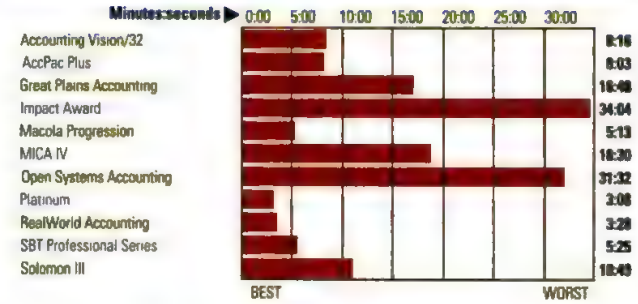
In our fault tolerance test, we powered off the workstation during the posting of Accounts Receivable invoices. As an additional test, we disconnected the network cable from the server during the posting of invoices.

ORDER ENTRY DEGRADATION

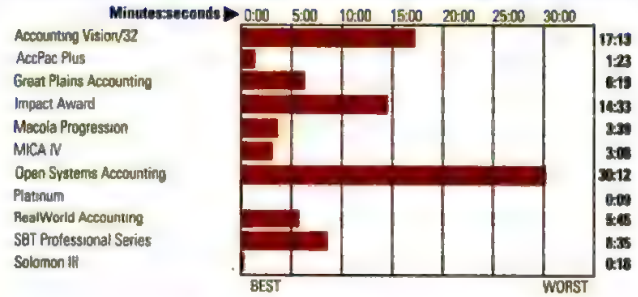


* Solomon III's performance was significantly degraded because of a bug in the software when a default warehouse location was specified in a single-warehouse configuration. Users will likely see substantial improvement in performance if no warehouse is specified

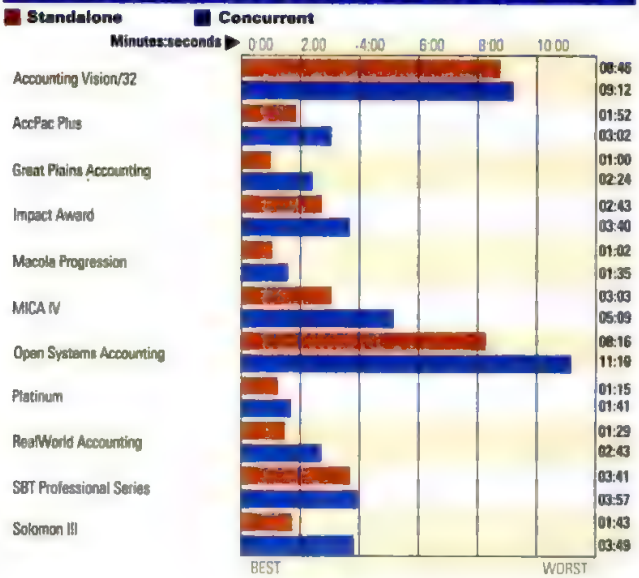
TOTAL POSTING TIME



FINANCIAL REPORTING



STANDALONE VS. CONCURRENT PRINTING



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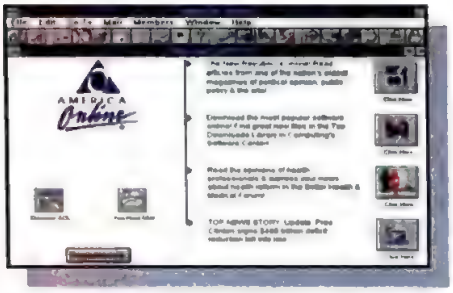
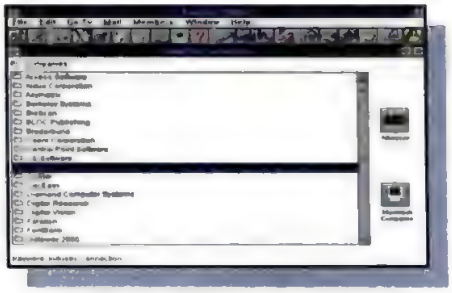
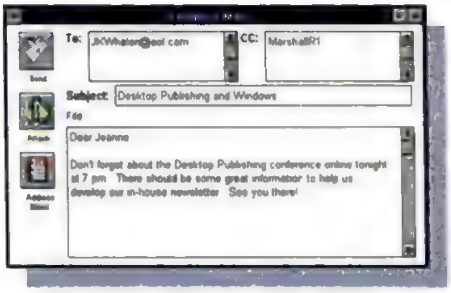


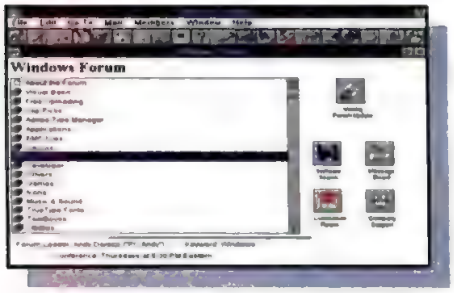
PC *and* Microsoft Windows Versions



Expert Computing Advice

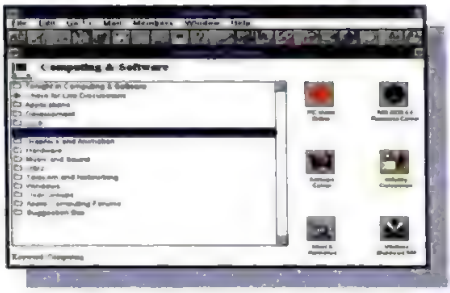


Internet E-Mail Gateway

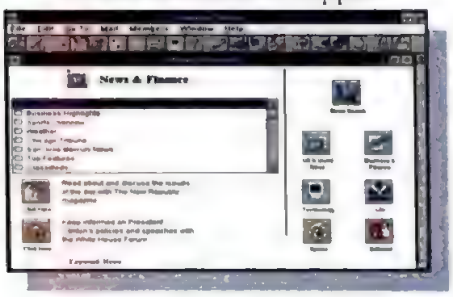


Windows Advice & Support

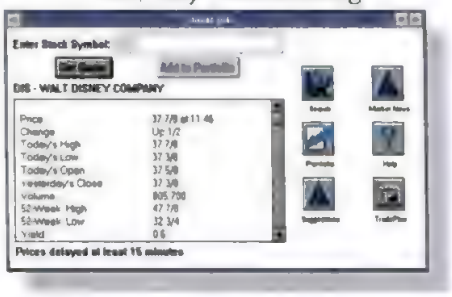
Fast, Easy Downloading



More Than 30,000 Software Files



Searchable News



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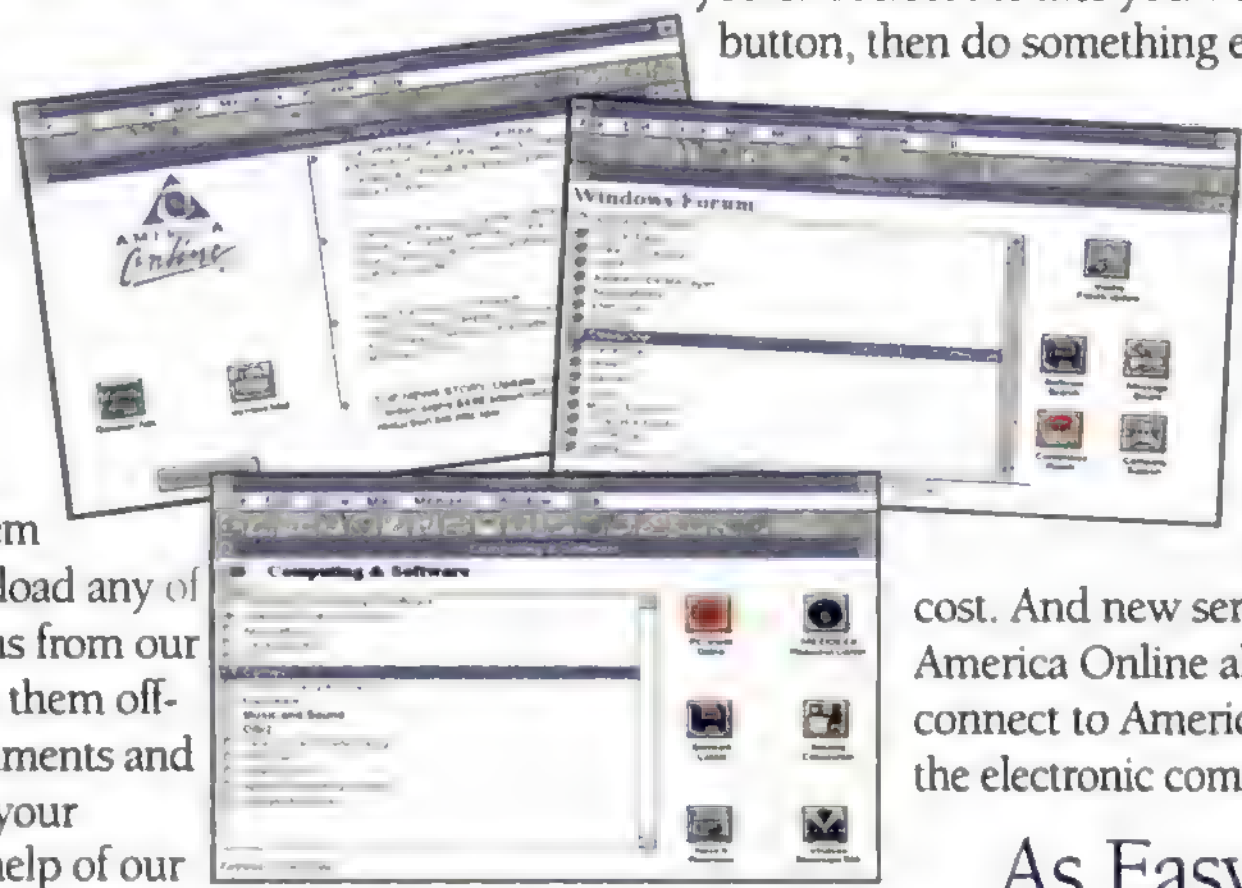

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REPORTING

In addition to its standard reports, Great Plains offers a variety of reporting tools. Great Plains' Executive Advisor, included with the System Manager, displays key management information both graphically and in report format. Also, for extensive financial reporting, Great Plains offers its own version of the FRx report writer.

For customized operational reports, you'll want to consider Great Plains' Report Maker Plus. It's a modified version of Xtrieve Plus that allows read-only access to Great Plains data files. Other reporting options include Great Plains' versions of Forest & Trees, F9, and @trieve.

CUSTOMIZATION, SECURITY, AND IMPLEMENTATION

Great Plains Software does not release its source code to customers or developers. On the other hand, the company does provide open access to its data files for developers using third-party development tools. These tools include Magic PC, Microsoft Access, and ObjectVision. Great Plains has an extensive directory of over 150 ready-to-use third-party developed, vertical market, and enhancement products, including EDI links to bar code interfaces.

A comprehensive audit trail in Great Plains includes system-assigned document and transaction source codes, as well as user-defined reference codes. When transactions are posted in detail from the submodules to the G/L, up to two additional lines of 30 characters are available to further describe the transaction.

Great Plains Software continues to be the model in the accounting industry for supporting customers, resellers, and consultants. The support plans available from Great Plains range from cash-per-call to the Comprehensive Plan. The latter includes a guaranteed response time, free software upgrades, training at Great Plains University, and an assigned specialist.

New ease-of-use features, improved reporting, the product's well-deserved reputation for support, and a well-rounded set of features make Great Plains a good choice for many businesses.

Syspro Impact Software Inc.

Impact Award

BY LEE HILLS

Impact Award, Version 3.0, from Syspro Impact Software brings functionality traditionally found in minicomputers to the LAN environment. Competitively priced at $1,000 per module for four users (increasing approximately $400 per module for an additional four users), Impact Award runs on DOS-based LANs, Unix, and Xenix platforms. A relative newcomer here, the product has been sold for many years in Europe, where Syspro's parent company is based and where the package has a large installed base.

SUITABILITY TO TASK

Impact Award

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	○
Managing orders and inventory	●	●	●	●
Reporting	●	●	●	○
Customization and implementation	●	●	●	●
Auditing and securing data	●	●	●	○

Impact Award's DOS-based interface can be cumbersome and a bit frustrating. The F1 key, for example, is used to exit the current field or back out of a screen (as, on occasion, is the F2 key), while SHIFT+F5 is used to display Help text. Many of the Help screens are incomplete, and the lack of indexes in the user manual significantly detracts from the package's usefulness. Syspro is preparing a GUI interface for Version 4.0 that should address these shortcomings. That new version is due out by the end of 1993.

Another shortcoming in Impact Award is that nontransaction screens prompt you for data one line at a time, as if you were using a bulletin board. In other words, if you're at the bottom of the screen and realize you've made a mistake on the first line, you must re-enter the entire screen or save and re-edit the file completely.

FINANCIAL ACCOUNTING

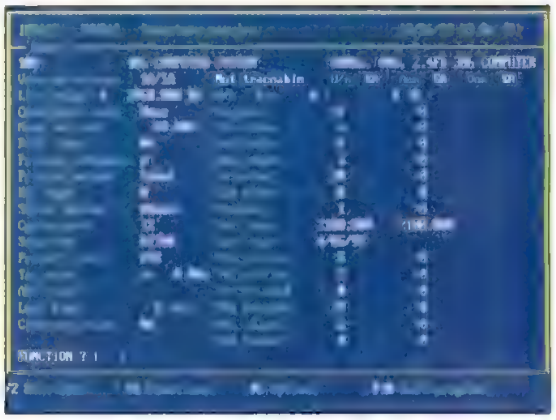
Impact Award's G/L, A/P, and A/R modules provide basic functionality with a few nice surprises thrown in. The format of the G/L account number is user-defined, but the number can't exceed 15 characters. Furthermore, up to 10 budgets can be maintained per account, per period, and you can assign passwords to secure account posting and inquiry.

A unique feature found in A/R is the ability to designate customer parent/child relationships. For example, if you're selling to a large company but shipping to branch locations, you can track receivables at the parent or child level and track sales history for reporting purposes at the child level.

Although Impact Award will track foreign currency transactions—for purchases and sales, for example—the program does not provide full FASB 52 foreign currency consolidations.

MANAGING ORDERS AND INVENTORY

Where Impact Award really excels is in order processing and inventory management. Item pricing can be determined from the customer file or through a sophisticated item/customer price matrix. If your business requires contract pricing, Impact Award should satisfy your needs. You can enter future orders, scheduled orders with specific ship dates for each line item, and orders for interbranch transfers. Interbranch transfers don't update sales analysis information, but they do provide the complete transaction trail that is missing when the orders are



Syspro's Impact Award provides exceptional functionality, particularly in the inventory and order-processing functions.

FACT FILE

Impact Award, Version 3.0
Syspro Impact Software Inc., 1801 E. Edinger, #165, Santa Ana, CA 92705-4709; 800-369-8649, 714-541-2202; fax, 714-541-0662

List price: $600 per module; 4-user module, $1,000, 8-user module, $1,400

Requires: Server: 15MB hard disk space, NetWare, any NetBIOS-compatible system, Impact System Manager. Workstation: 2MB RAM, DOS 3.0 or later. Unix/AIX workstation requires 1MB RAM.

In short: Impact Award addresses the basic accounting applications well and has unexpected capabilities in credit management and transaction inquiry. The Order Entry, Inventory, and Purchasing modules have a tremendous amount of flexibility and functionality. Functions like the landed-cost system, customer pricing, and sales analysis stand out in these modules.

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completed in the inventory module.

Commissions can be assigned to line items, but the feature is limited to one salesperson per order. You can also specify the item's warehouse location and tax rate. At order entry, you can either key in the item number or the customer's identification number.

Impact Award includes both kitting and product configuration capabilities. For those who require serial or lot number tracking, Impact Award provides a comprehensive tracking system that includes several handy reports and inquiries.

The tracking system tackles such tricky functions as landed cost, multiple stocking locations within a warehouse, and mass changes to prices or costs. Impact Award supports cycle counting and full physical counts. A snapshot of inventory quantities is made at the beginning of the count, allowing daily inventory transactions to continue during the process.

Integration between the G/L and Inventory modules is flexible. The latter module allows you to define separate G/L accounts for each inventory transaction type/product and class/warehouse combination. In addition, Impact Award includes a full line of manufacturing software.

REPORTING

Impact Award offers three types of reporting: standard reports, financial statements, and custom reports created using the Report Writer module. Reports contain multiple selection criteria and, in some cases, user-selected sort options.

The financial report writer isn't the most user-friendly tool, but it does provide a good deal of functionality, including up to 10 run-time prompts when you run a report. The database Report Writer can link multiple files. Additionally, during report definition, Impact Award provides a full data dictionary containing file and field definitions as well as file linkages.

Finally, you'll find the form-based data inquiry capabilities quite good.

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Impact Award designers took extra care to provide inquiries that display the information that is vital to the operation and management of the business. For example, the inventory inquiry will not only display item details such as cost and quantity, but it will also display a complete transaction history, which will include all the sales, receipts, and movement transactions.

CUSTOMIZATION, SECURITY AND IMPLEMENTATION

Although Syspro will customize its COBOL source code for customers, most users should be able to adapt the standard Impact Award to their needs. A variety of options that ultimately change the way the software modules behave—such as allowing negative inventory quantities, or determining a sales commission basis—are offered during installation.

Also, you can add or change menus and data entry screens for individual users. A helpful feature is the ability to set up a fast menu with often-used functions that can be called up at any time. Features aside, this is a complex setup routine. You will want to consider using a consultant during installation.

Password security can be assigned down to the function level for each user. For further security, a supervisor can review Impact Award's log file that lists the process executed, the user ID, and the duration the process was in use.

Impact Award's support base in North America is relatively small in comparison with most other products in this roundup: There are no third-party developers, and the number of authorized resellers and consultants is also relatively small.

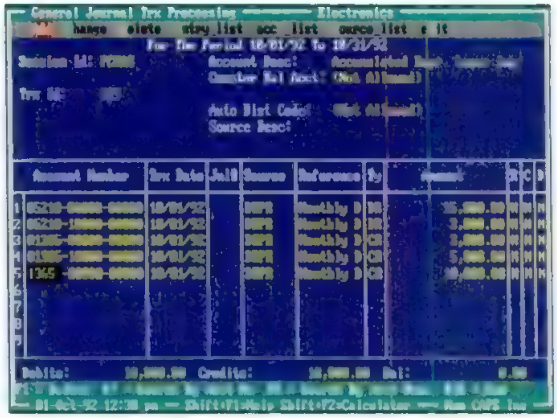
Although Impact Award's user interface may frighten some potential users away, those companies that require high-end inventory and order-processing features probably won't need to look any further.

Macola Inc.

Macola Progression

BY EDWARD KNEITEL

With over 170 new features across its entire suite of software, Macola's Macola Progression, Version 6.0, has a strengthened position as a comprehensive



Macola Progression, Version 6.0, has cleaned up some data entry screens, allowing multiple distribution lines to be viewed from a single screen.

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accounting system for companies with general financial, heavy distribution, and light manufacturing needs. Macola ($995 for nonmanufacturing modules) consists of character and Windows-based versions of the System Manager. Since you can run both on the same network, you can give the Windows version to those who want it, while traditionalists can keep their familiar character-based version.

FINANCIAL ACCOUNTING

Macola's G/L offers a 15-character, three-segment account code—more than enough for the average business. Consolidation codes can be assigned to each account number for roll-up to a consolidation company, so merging companies with dissimilar charts of accounts is no longer an insurmountable task. And, to add new profit centers and departments, just copy the desired range of main accounts.

Macola redesigned its journal entry screens to display up to nine lines of the entry. In the past, you could only enter one line on a screen. Also, you can store and report on unlimited years of budget and history data, including up to 99 budget revisions per account. The custom financial statement features, which take some practice to master, offer enough flexibility to create financial reports with up to 13 columns. Macola does not offer multicurrency capability.

The A/R customer masterfile keeps track of myriad details, such as last sale date/amount, balance by aging periods, and credit data, all of which can conveniently be displayed through an inquiry option. Frequently used noninventory billing codes can be set up with standard descriptions and G/L account links, and can be used in preparing customized invoices. Salespeople can also be set up here, as commissions due will be tracked for billing in both A/R and Customer Order Processing.

SUITABILITY TO TASK

Macola Progression

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	○
Managing orders and inventory	●	●	●	●
Reporting	●	●	●	○
Customization and implementation	●	●	●	●
Auditing and securing data	●	●	●	●

Macola's A/P module is virtually unchanged from its earlier version, with features such as seven user-defined note fields accessed through the vendor masterfile, and strong void check processing both before and after posting. Still lacking in Version 6.0 is a true bank reconciliation module, which would capture A/P and A/R data to assist in reconciling one or more bank accounts. The check reconciliation feature that currently exists in A/P is only a small step toward automating this typically time-consuming process.

INVENTORY AND ORDER MANAGEMENT

Macola's distribution facilities found in its inventory and order management modules have always been its strength, and Version 6.0 adds even more muscle. The old features remain, such as seven user-defined fields in the item masterfile, five costing methods, serial and lot tracking, and multilocation processing. Cycle counting can also be performed, with count worksheets printed based on codes assigned in the item masterfile.

One new feature is kit processing, which lets individually stocked items be sold as a functional group. For example, when all components that go into a computer are sold as a unit, the inventory is automatically relieved for all the included items. The kit item can have a user-defined or rolled-up component cost.

Also added is the ability to freeze inventory prior to physical count processing. This feature saves the item cost and quantity as of a point in time, and allows normal post-cutoff processing to continue until the physical count has been entered and posted.

Order entry, billing, and reporting in Macola's Customer Order Processing (COP) module are streamlined and intuitive. The pricing table has always been an impressive distribution-oriented feature. It allows billing calculations to be made in up to eight different ways, and includes an item-specific sale price with starting and ending sale dates.

Order entry lets commissions be split among three salespeople and allows up to three separate tax calculations. Item substitutions can be suggested for out-of-stock items, kit pricing can be modified at the component level, and invoices can be printed on demand. On-screen inquiry by order, customer, and item is also at your fingertips. As there is no shipping function available in COP (a third-party shipping module is available), order billing is simply a means of generating a user-defined invoice for individually selected orders.

Macola's Purchase Order module now allows for either batch or on-line postings of receipts to Inventory, where batch mode will capture valuable transaction data as well. Receivings accruals (amounts received but not invoiced) can be posted to G/L and can also be tracked through purchase-order line-item history and receivings reports.

REPORTING

Macola offers moderate flexibility in its standard report formats. In the distribution area, there are numerous sales analysis and history reports in COP; transaction history can be stored indefinitely. Purchase and receiving history reports are available through PO, and full inventory activity reports can be run from the inventory module.

If you need more customization fea-

EDITORS' CHOICE

FACT FILE

Macola Progression, Version 6.0

Macola Inc., 333 East Center St., Marion, OH 43301-0485; 800-468-0834; fax, 614-382-0239.

List price: $995 per module; 5-user system manager, $995; $995 for each additional 5 users.

Requires: Server: 8MB RAM, 300MB hard disk space, NetWare 3.1 or later. DOS workstation: 640K RAM, 1MB hard disk space, DOS 3.1. Windows workstation: 4MB RAM, 1MB hard disk space, Windows 3.1

In short: Macola's distribution modules (Inventory Management, Customer Order Processing, Purchase Order and Receiving, and Bill of Materials) are the heart of its accounting software library. They are well complemented by Macola's financial and manufacturing modules and a host of third-party applications.

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tures, beyond G/L's custom financial statements, there's always FRx—a powerful add-on module for enhanced G/L reporting. Macola's new Windows-based EnVision report writer, which works with all modules (including the G/L), is powerful yet easy to use.

CUSTOMIZATION AND IMPLEMENTATION

Macola continues to offer an open approach to modifying its software, which can be accomplished by purchasing the source code or contracting with Macola or a licensed Macola COBOL or Btrieve developer (there are approximately 200).

Macola allows you to launch external applications from a utility menu, but you can't alter Macola's own standard menus or data entry screens. Look for these features and more in the client/server EnVision version of Macola, targeted for a phased release beginning in late 1993.

Additional Macola-developed modules, such as EDI Interface and Bar Code, as well as a host of third-party programs, serve to enhance Macola's already strong core applications.

Overall, Macola succeeds in offering a broad range of solutions to a diverse user base. It particularly targets the distribution environment with enhanced features in its inventory-related applications while offering strong core financials, source code modification opportunities, and GUI compatibility.

MICA Accounting Software

MICA IV

BY W. WESLEY HOWARD III

For businesses with straightforward accounting needs, MICA IV, Version 2.01, from MICA Accounting Software offers easy installation, an exceptional user interface, and broad functional capabilities. But for more complex businesses or those requiring top-notch performance, MICA falls short. The MICA lineup consists of nine modules, most of which are priced at $795.

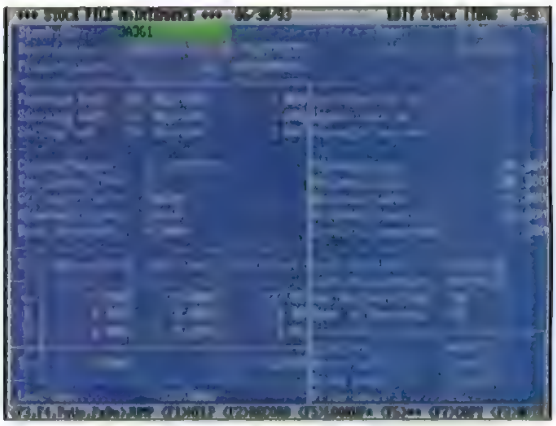
MICA's superb ease of use shines in single-company operations. Masterfile setup sails smoothly, and on-line help suffices to solve most dilemmas. Furthermore, streamlined transaction entry throughout MICA and automatic posting from interfaced modules provide a remarkably easy yet powerful medium-size business accounting environment. On the other hand, running multicompany operations with consolidations, by comparison, can tax both MICA's capabilities and user patience.

There's also a minor interface glitch: MICA's editor, a holdover from the package's CP/M operating system origins, uses outmoded backspacing. In MICA, using the Backspace key deletes the character at the current cursor position, then moves left, whereas in most DOS software, using Backspace deletes the character to the left of the cursor position.

MICA rightfully deserves high honors for ease of installation and implementation. MICA installs faster than most $29 PC games. The strictly text-based user interface operates intuitively, even for users with limited accounting-package exposure, and all functions are easily accessed.

MICA offers two mutually exclusive methods of multicompany setup. One setup method is for unrelated companies on separate ledgers and the other is for consolidated companies on a single ledger. The manuals, resembling the software guides of a decade ago, poorly document this setup feature.

Even after conquering multicompany setup, frustrations lurk. Posting from interfaced modules to the G/L becomes a chore because MICA mysteriously disables the automatic posting feature for consolidated companies. Furthermore, the current release—2.01—allows operators to inadvertently duplicate postings. Representatives at MICA Accounting say that the next release of MICA will be able to display a warning before redundant postings occur.



MICA's Stock File Maintenance Screen, the heart of the inventory system, displays a helpful inventory item status snapshot.

ORDER MANAGEMENT AND INVENTORY

MICA's Inventory module includes such features as serial/lot tracking and a 40-level bill of material for assemblies, subassemblies, and kitting. MICA Accounting also sells Job Costing as a separate, interfacing module.

But the absence of standard costing tarnishes MICA's otherwise sterling Inventory functionality. Without standard costs and the related variance reporting so many businesses count on, users must face a limited choice of the average, weighted average, LIFO, and FIFO costing methods for regular, nonserialized inventory.

Working together, the Sales Order Entry and A/R modules provide excellent functionality. Without the Sales Order Entry module, however, the A/R module's invoicing function operates only in an after-the-fact mode. It will not provide printing of even the most rudimentary customer invoices. This forces users to buy Sales Order Entry, import invoicing data from an external system, or produce invoices off-line and rekey the data into MICA's A/R.

SUITABILITY TO TASK

MICA IV

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	○
Managing orders and inventory	●	●	●	○
Reporting	●	●	○	○
Customization and implementation	●	●	○	○
Auditing and securing data	●	●	○	○

REPORTING AND QUERIES

In addition to a host of standard reports, MICA also has its own financial report writer. The company also sells Intelligent

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12360 ProLinea 4/50 240 MB, Windows..... *while supplies last* 1549.
10893 ProLinea 4/50 Local Bus, 240 MB, Windows.. 1899.
10894 ProLinea 4/50 Local Bus, 240 MB, Windows, Modem, PFS Window Works, Prodigy..... 1999.
12178 ProLinea 4/66 Local Bus, 340 MB, Windows, Modem, PFS Window Works, Prodigy..... 2299.
9552 Contura 3/25 120 MB, Windows..... *while supplies last* 1599.
11420 Contura 4/25 with 209 MB, Windows..... 2199.
11417 Contura 4/25C with 209 MB, Windows..... 2889.
11646 DESKPRO 4/66M with 510 MB, Windows..... 3619.
2016 LTE Lite 4/25 with 120 MB, Windows..... 2525.
3019 LTE Lite 4/25E with 120 MB, Windows..... 3099.
3029 LTE Lite 4/25E with 209 MB, Windows..... 3385.
Monitors not included.

Texas Instruments
4757 TM 4000 WinDX/25 Notebook with 120 MB... 2059.
6388 TM 4000 WinSX/25 Notebook with 120 MB... 1899.
6441 TM 4000E WinDX2/50 Active Matrix Color Notebook with 200 MB..... 3799.
4696 TM 4000E WinSX/25 Advanced Passive Color Notebook with 120 MB..... 2149.

BUSINESS APPLICATIONS

Automap
2729 Automap USA for DOS.. 55. 8569 Windows.. 55

Borland International
6788 Quattro Pro 5.0 for Windows *(3½" only)*..... 95
10710 Paradox Windows *(3½" only) while supplies last* 129.
11915 Borland Office for Windows *(3½" only)*..... 395
11978 Office for Windows Comp. Upgrd. *(3½" only)*... 299

Caere
4277 OmniScan..... 279.
8933 OmniPage Professional 2.1..... 629.

CE Software
3532 CE Power Pak *(3½" only)*..... 79.

Claris Corporation
6022 ClarisWorks for Windows with Quicken Bundle 119
5257 FileMaker Pro for Win. 119. 5228 Comp. Upgrd 95

Intuit
2426 Quicken 6.0... 45. 5596 2.0 for Windows..... 45

LaserTools
6862 PrintCache 3.1..... $49.

Lotus
2756 1-2-3 4.0 for Windows *(2755 5¼")*..... 309
3428 1-2-3 4.0 for Windows Upgrade *(3424 5¼")*..... 99
2546 Ami Pro 3.0 Competitive Upgrade *(1847 5¼")*... 99
6657 Improv for Windows 2.1 *(3½" only)*..... 319
5982 SmartSuite 2.0 *(5981 5¼")*..... 469.

MECA
2796 Managing Your Money..... 32.

Microsoft
11325 MS-DOS 6.0 Upgrd. *(3½")*.. *while supplies last* 47.
7009 Windows 3.1 *(7010 5¼")*..... 89.
7841 Word for Windows 2.0C Comp. Upgrd. *(3981 5¼")* 125
5695 Excel 4.0 Competitive Upgrade *(5693 5¼")*..... 99.
2931 Access for Windows 1.1 *(2932 5¼")*..... 299
10057 FoxPro 2.5 for Windows *(10056 5¼")*..... 299
8138 Office 3.0 for Windows *(8137 5¼")*..... 449
12848 Office Professional *(with Microsoft Access)*..... 589.

Peachtree
12287 Accounting for Windows Release 2..... 115

Polaris Software
4395 PackRat 5.0..... 249

Symantec
1625 ACT! for DOS 2.11 259. 7435 Windows 1.03 259

TIMESLIPS
5698 Timeslips Release 5 1.0..... 189.

WordPerfect Corporation
3445 Presentations 2.0 for Windows 299 7582 DOS 279.
1501 Presentations for Windows Comp. Upgrade.... 105
12351 Presentations 2.0 for DOS Comp. Upgrade..... 105.

Texas Instruments
6441 *TravelMate 4000E WinDX2/50 Active Matrix Color Notebook*—6.3 pounds, 200 MB, 16 ms IDE Hard Drive, 8.4" Active Matrix Color Display, 4 MB Ram (upgradeable to 20 MB), 1.44 MB Floppy, Trackball... **$3799.**

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3497 WordPerfect 5.2 for Windows *(3494 5¼")*..... 279
4795 WordPerfect for Windows Ver. Upgrd. *(4786 5¼")* 99

GRAPHICS & DESIGN

Adobe Systems
10774 Adobe Photoshop 2.5 for Windows *(3½" only)*.. 548
6439 Adobe Illustrator 4.0 for Windows *(6591 5¼")*.. 429
5475 Adobe Illustrator & Photoshop Bundle..... 599.

Aldus
1085 FreeHand for Windows..... 395
11667 PageMaker 5.0 for Windows *(3½" only)*..... 579.
6678 PageMaker 5.0 Upgrade *(3½" only)*..... 139.

Microsoft
2840 *Flight Simulator 5.0*—It's never been more real! Scenery disks available!..... **$42.**
[illegible]—Stunning photorealism!.... **45.**
6103 *Arcade 1.0*—Arcade Asteroids, Battlezone, Centipede, Missile Command, & Tempest **27.**

Altsys Corporation
8675 Fontographer for Windows 3.5 *(3½" only)*..... 259.
12551 Fontographer & Typestry Bundle..... 279.

Application Techniques
1214 Pizazz Plus 4.0 *(Windows & DOS included)*..... 79.

Corel Systems
5508 CorelDRAW! 3.0 *(5506 5¼")*..... 139.
11896 CorelDRAW! 4.0 *(11904 5¼")*..... 389.
7923 CorelDRAW! 4.0 Upgrade *(7922 5¼")*..... 225.

DeltaPoint
3435 Graphics Tools! 1.0 for Windows *(3½" only)*..... 99.

Fractal Design
7822 Sketcher 1.0 for Win. 94. 4356 Painter 2.0 259.

Inset Systems
3820 HiJaak Pro 2.0 for Win 82. 7298 HiJaak 2.1 92.

Lotus
5005 Freelance Graphics 2.0 for Windows *(3523 5¼")* 349.

Micrografx
3628 Windows Draw! 3.0 *(3627 5¼")*..... 69.

Microsoft
10051 Font Pack 2 Win.... 45. 3337 Publisher 2.0 Win. 89.
2840 Flight Simulator 5.0 42. 8491 Golf 1.0..... 45.
6103 Arcade 1.0..... 27.

Pixar Corporation
12552 Typestry & AGFA Discovery Bundle..... 189.

Shapeware
5426 Visio 1.0 for Windows *(3½" only)*..... 199.

Software Publishing
4402 Harvard Graphics for Windows *(4403 5¼")*..... 369.

SYSTEM UTILITIES & PROGRAMMING

AddStor
12029 DoubleTools..... 55.

Avery Dennison
6006 Label Pro 1.6 *(Laser)*..... 45.

Berkeley Systems
6642 Disney Collection Screen Saver *(3½" only)*..... 29.
9885 After Dark 2.0 for Windows.. 29. 3528 DOS.. 29.
12030 More After Dark (M.A.D.) for Windows *(3½" only)* 23.
6649 Star Trek: The Screen Saver *(3½" only)*..... 34

Central Point Software
11393 Safe Six for Windows 1.0 *(3½" only)*..... 37.
9555 Anti-Virus 2.0 *(9751 5¼")* or 8114 Backup 8.0 *ea.* 89.
5039 PC Tools 8.0... 125. 11395 for Windows..... 84.

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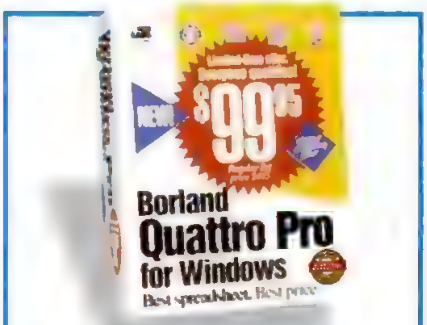

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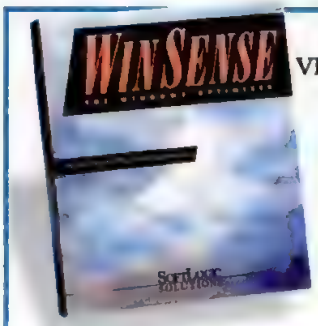

Softlogic Solutions
10868 *WinSense 2.0*—Fine tune your own Windows 3.1 environment easily & logically. WinSense develops a user profile to maximize Windows performance. Incl. automatic backup and an on-line database ..... **$42.**

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3950 Fastback Plus 6.0.. 95. 6431 1.1 for Windows . 95.
4187 Fastback Plus for Windows Comp. Upgrade 1.1 65

Hewlett-Packard
8731 Dashboard 2.0 for Windows 45

Micro Logic Corporation
6787 Info Select DOS 12145 Windows ..... *ea.* 87.

Microsoft
10154 Visual Basic 3.0 Windows Std. Ed. *(3½" only)* .. 129
11444 Visual C++ Standard Edition *(3½" only)* ..... 125.

PC-Kwik
8004 PC-Kwik Power Pak 3.1 w/Power Disk *(4925 5¼")* 45.

Qualitas
12541 386MAX 7.0 ..... 59.

Quartardeck
3217 QEMM 7.0 *(3221 5¼")* ..... 59.

Softlogic Solutions
10868 WinSense 2.0 42

Stac Electronics
1409 Stacker 3.1 95

Symantec
2360 The Norton Desktop 2.2 for Windows *(2359 5¼")* 115
5136 The Norton Utilities 7.0 *(3146 5¼")* ..... 115.
8535 pcANYWHERE DOS 119. 11303 Windows 129

TouchStone Software
11665 CheckIt Pro: Set *(Volumes I & II included)* ..... 79.

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8957 XTree 2.0 for Win. 49. 6161 XTree Gold 3.0 95.

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3 Com ... lifetime (conditional)
3453 EtherLink II/16..... 159. 3469 II/16 TP ..... 169.

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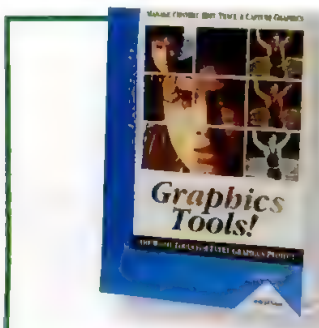
2775 8 Port Hub..... 249. 2772 12 Port Hub..... 499.
EtherPac Ethernet Cards ..... call

Artisoft
2234 Lantastic AE-2 EtherNet Starter Kit DOS 5.0... 459.
2452 AE-2 EtherNet Adapter Card ..... 199.



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3435 *Graphics Tools! 1.0 Windows (3½" only)*—Organize your graphics in a drag and drop thumbnail viewer, convert files, autotrace, image editing, painting, screen capture, 700 pieces of clip art and dozens of photos **$99.**

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1189 PC/Mac Connector 1.0 ..... 179.

CompuServe
10957 Windows Membership Kit 1.0 *(3½" only)* 27

Data Storm
4798 PROCOMM PLUS 2.01 69. 2006 for Windows 95.

DCA/Crosstalk
5611 Crosstalk 2.0 for Windows ..... 119.

Delrina Technology
2446 WinFax PRO 3.0.. 79. 5974 DOSFax PRO.. 49.

Hayes ... 2 years
11397 ACCURA 144 + FAX 144 *(int.)* 199. 11396 *(ext.)* 229.
7391 ULTRA 96 Modem.. 599. 5024 ULTRA 144 . 669.
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1531 FaxModem 14.4/14.4 *(int.)* 175. 1536 *(ext.)* 199.
5994 SatisFAXtion Modem/400 5995 Modem/400e *ea.* 399.

Megahertz ... 5 years
10515 C5144 14.4 Fax/Modem *(Compaq LTE/Contura)* 419.
10517 C524FM Fax/Modem *(Compaq LTE/Contura)* .... 215.
11817 XJ124FM 24/96 Fax/Modem *(PCMCIA card)* ..... 289.

Microcom
6234 CarbonCopy Plus 6.1 129. 4410 Windows 129

Microsoft
5743 Windows for Workgroups *(6207 5¼")* 149
6172 Windows for Workgroups Add-on *(6141 5¼")* ... 59

Norton-Lambert
2754 Close-Up Dual Pack 4.0 *(2753 5¼")* 119

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ACCURA 144 + FAX 144—Legendary Hayes quality at an affordable price! Offers speed, versatility. The automated send/receive fax software has superior readability, & confidentiality. 11397 *(internal)* **$199.** 11396 *(external)* **$229.**

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11441 SupraFaxModem V.32bis External for DOS .... 239.
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Traveling Software
4407 LapLink V 99

U.S. Robotics
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11922 WorldPort 14.4 Pocket FaxModem ..... 329.
11918 Courier V.32bis FAX Int..... 359. 11919 Ext. 399.

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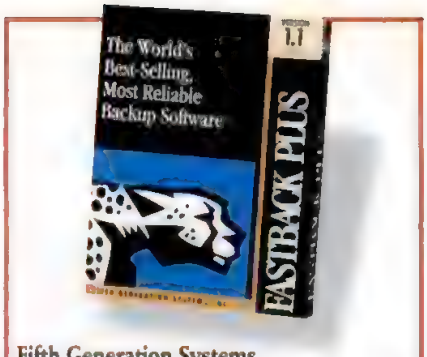

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4429 FaxModem VFP V.32bis 14,400 baud *(internal)* 149.
4428 FaxModem VFX V.32bis 14,400 baud *(external)* 189.
10858 FaxServer 215. 7921 Pocket FaxModem 24/96/48 87.

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3886 Graphics Ultra + 2 MB.. 249. 3871 Pro 2 MB.. 369.
11022 Graphics Ultra Pro EISA *(with 2 MB)* ..... 399..

Boca Research ... 5 years
12374 VORTEK VRAM Accelerator 2 MB ..... 289.

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Diamond Computer ... 5 years
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1569 Stealth 24 VLB.... 159. 1585 Viper VLB .... 415.

Gold Disk, Inc.
10871 Video Director 1.0 for Windows 119

Intel ... 3 years
11587 Smart Video Recorder ..... 499.

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11700 HD-6 speakers *(with AC Adapter)* ..... 79.

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11462 SoundMan 16 ..... 139.

Media Vision ... 3 years
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12028 ProAudio Studio 219. 11478 ProMovie Spectrum 299.

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11949 MultiSync 3FGE Monitor *(13")* ..... 629.
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Epson ... 2 years
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11800 LQ570+ *(80 col., 269 cps)* ..... 269.
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11495 Stylus 800.. 369. 10784 ActionLaser 1500.. 789.
Hewlett-Packard ... 1 year
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Key Tronic ... 3 years
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3295 Mouseman *(combo)*... 69. 9766 *(cordless)* .... 89.
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Microsoft ... lifetime
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Intel ... 3 years
4750 80387SX..... 79. 5409 80387DX ..... 85.
Kensington Microware ... 1 year
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2582 MasterPiece Plus..... 95. 2587 Remote..... 105.
PC Power & Cooling ... 2 years
9537 CPU Cooler *(for 386/33 up to 486)* ..... 29.
3203 Turbo Cool 200.. 149. 7915 Turbo Cool 300. 159.
Targus ... lifetime
7369 Notepac 35. 1305 Univ. Notebook Computer Case 69.
Tripp Lite ... 2 years
6199 Isobar 4-6 *(4 outlets, Gold Seal Warranty)* ..... 43.
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5550 BC250 Battery Backup.. 119. 9312 BC500... 219.

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2530 90 MB Cartridge..... 129. 2467 Tripak ..... 379.
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10702 Tape250 Parallel Port Tape Backup ..... 429.

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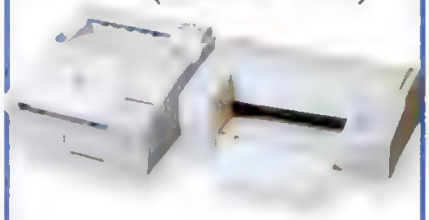

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4863 3.5" HD Disks *(20)* with storage case ..... 24.
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Kao
11870 3.5" HD Disks *(10)*..... 12. 11869 *(30)* ..... 35.
11867 3.5" HD Disks *(50)* ..... 50.
Sony ... 1 year
3298 3.5" HD Disks *(10)* 13. 6375 *(30)* ..... 37.
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3M ... lifetime
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11013 DC2120 Tape Cartridge *(3 pack)* ..... 60.

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FACT FILE

MICA IV, Version 2.01
MICA Accounting Software, 2349 Memorial Blvd., Port Arthur, TX 77640; 800-448-6422; fax, 409-983-5106

List price: $795 per module; single-user system manager, $125; $295 for each additional 4 users.
Requires: Server: 640K RAM, 12MB hard disk space, Novell, LANtastic. Workstation: 640K RAM, 12MB hard disk space, DOS 3.31 or later.
In short: An exceptional user interface, lightning-fast implementation, and broad functional capabilities make MICA IV a superb choice for single-company users with straightforward accounting needs. For more sophisticated operations, however, MICA falls short of other packages reviewed here.
ON READER SERVICE CARD

Query (IQ), a $795 third-party tool from Programmed Intelligence Corp that can be used to support ad hoc queries.

The financial report writer, true to form for MICA, presents little or no learning curve for the user. Users can produce basic custom reports within minutes.

On the other hand, careful scrutiny of the utility reveals a glaring weakness. The report writer doesn't support side-by-side, single-page presentation of data for multiple departments, divisions, or entities. An example of such output might be a multicolumn report that shows the comparative income and expenses of several divisions—and that's a task easily handled by competing packages. Constructing such a report in MICA necessitates a daunting programming effort using the IQ query tool.

CUSTOMIZATION AND SECURITY

MICA offers few methods to customize its menus—or anything else. As a result, MICA resembles a big house with one door and few windows. Only MICA Accounting can modify MICA's Quick Basic source code. Worse yet, the near-complete absence of third party add-on applications hamstrings expansion and enhancement. The fact that MICA is a relatively new product in the accounting arena might be attributed to this dearth of third-party support.

Determined users, as it turns out, are able to interface with external software by rigging front- or back-end applications using batch import and export of data to MICA. Users can also modify Help window content. Beyond those features, only a single main selection for accessing external applications links MICA to the outside world.

MICA's log-on requires entry of a single user name which doubles as a password. Only the system administrator can alter the user name. The system administrator also pegs one of four access levels, from *None* to *Total*, by user for each system function. A designation of *None* eliminates the function from the user's menus.

MICA's exceptionally easy installation and intuitive interface can be tempting, but its lack of third-party support and an inability to handle multicompany businesses may narrow its overall appeal for larger firms.

Open Systems Inc.

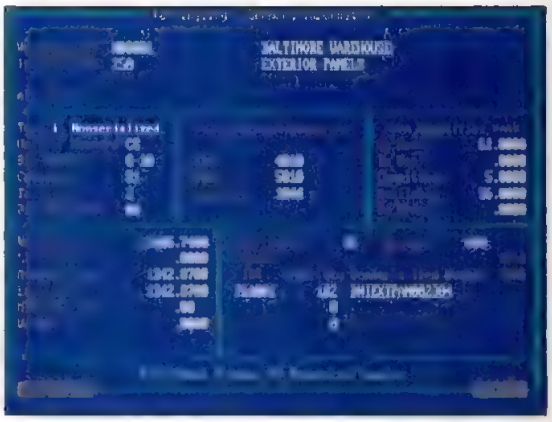
Open Systems Accounting

BY CHUCK AMERONGEN

Open Systems Accounting, Version 4.52, from Open Systems offers a wide range of standard applications and customizable source code. For $795 with most modules—the range is $395 to $1,995—you get a system with a long history, a large installed base, and an impressive amount of support from third-party developers.

FINANCIAL APPLICATIONS

The G/L account number can be up to 12 digits long and can be divided into four segments. Unfortunately, you still need to add each account/subaccount combination individually.



Open Systems' Item Inquiry consists of several screens of detailed information. This one includes quantity, cost, price, type and re-order information.

Some module highlights include the ability to capture statistical data and print it on financial reports, and a handy allocation feature that can be used to assign funds from one account to many accounts by percentage. Also, one budget and one forecast can be maintained per account per period. Open Systems will only keep the current year's transactions on-line, along with last year's account balances.

The A/P module includes a helpful inquiry function that displays invoice information in detail or summary for each vendor. The summary inquiry displays totals by period, and allows you to drill down to the actual invoices for a specified period.

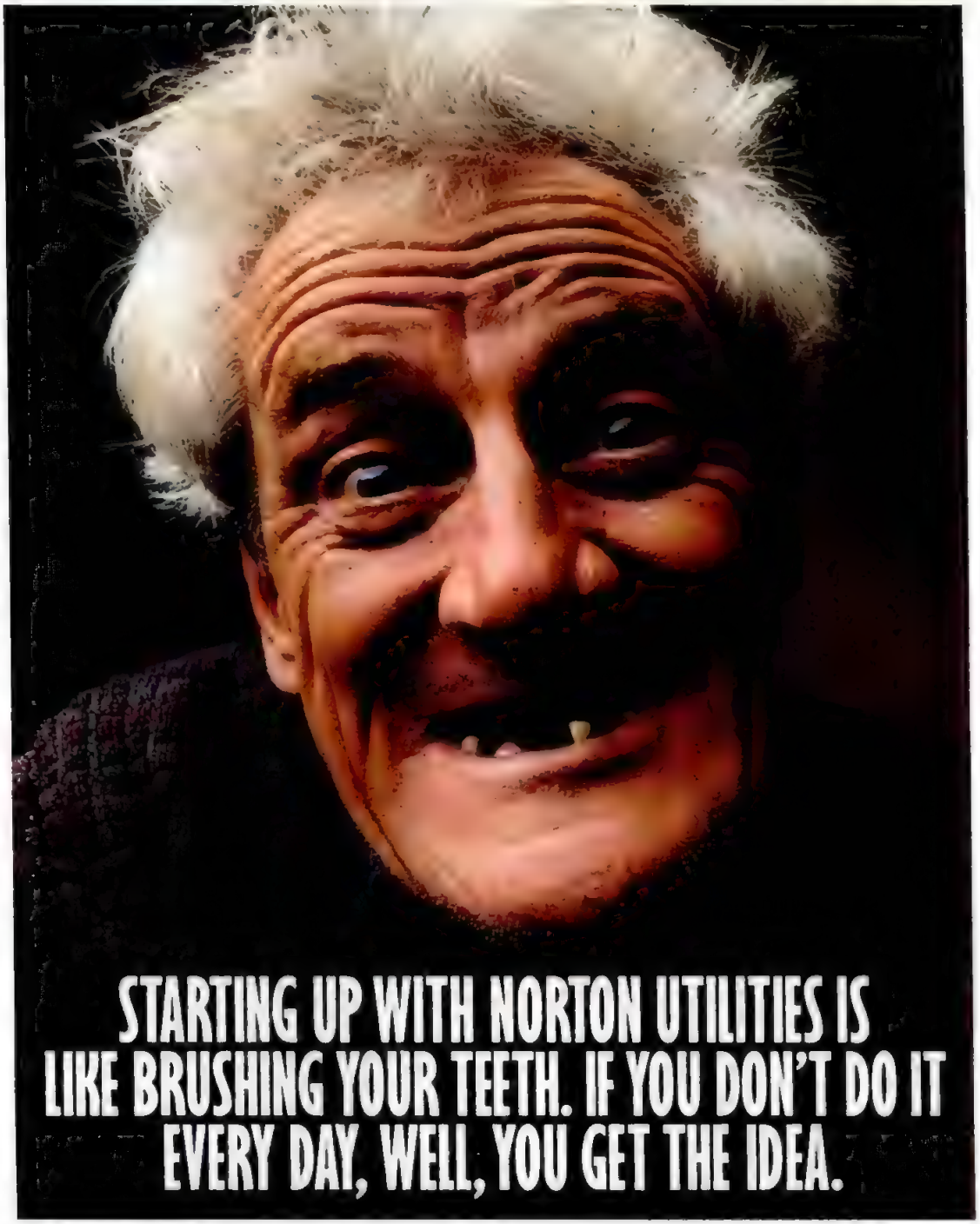
Included in the A/P module is a material requisition feature used to request items from inventory and assign them to a specific job. During invoice entry, up to three payment dates can be specified, and during payment selection, payments can be split for an invoice. These are certainly handy features if you're scrutinizing cash flow. A bank reconciliation module is also available to manage bank transactions.

Open Systems enables you to set up sales tax tables within A/R to track all sales tax activity by tax authority and location. The package will let you create and print a use-

SUITABILITY TO TASK

Open Systems Accounting

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	○
Managing orders and inventory	●	●	●	○
Reporting	●	●	○	○
Customization and implementation	●	●	●	●
Auditing and securing data	●	●	○	○



PC MAGAZINE EDITORS' CHOICE Sept. 14, 1993

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CIRCLE 334 ON READER SERVICE CARD

FACT FILE

Open Systems Accounting, Version 4.52

Open Systems Inc., 7626 Golden Triangle Dr., Eden Prarie, MN 55344; 612-829-0011, 800-328-2276; fax, 612-829-1493

List price: $395 to $1,995 per module

Requires: Server 640K RAM, 2MB hard disk space, DOS 3.1 or later. Workstation 640K RAM

In short: Open Systems Accounting offers customizable source code to its users, and a large number of third-party developers support the program. However, this support may not be enough of an incentive for users who need optimal network performance. OSA performed at or near the bottom on every performance test we ran

499 ON READER SERVICE CARD

ful report showing taxes actually collected versus what should have been collected by the appropriate tax authority or location.

ORDER MANAGEMENT AND INVENTORY

Open Systems' price code function is quite flexible. By setting up pricing codes, you can define markups or markdowns by individual item or item category. Start and end dates can also be defined for promotional pricing.

Sales commissions can be based on gross profit or amount of sale and earned at time of order or upon payment. Commissions for an order can be split between sales reps, and you can define whether commissions are earned on tax, freight, and miscellaneous charges or only on the items sold. Open Systems can process drop shipments but is unable to handle blanket orders. For businesses with walk-in trade, Open Systems can print packing slips and invoices at order time.

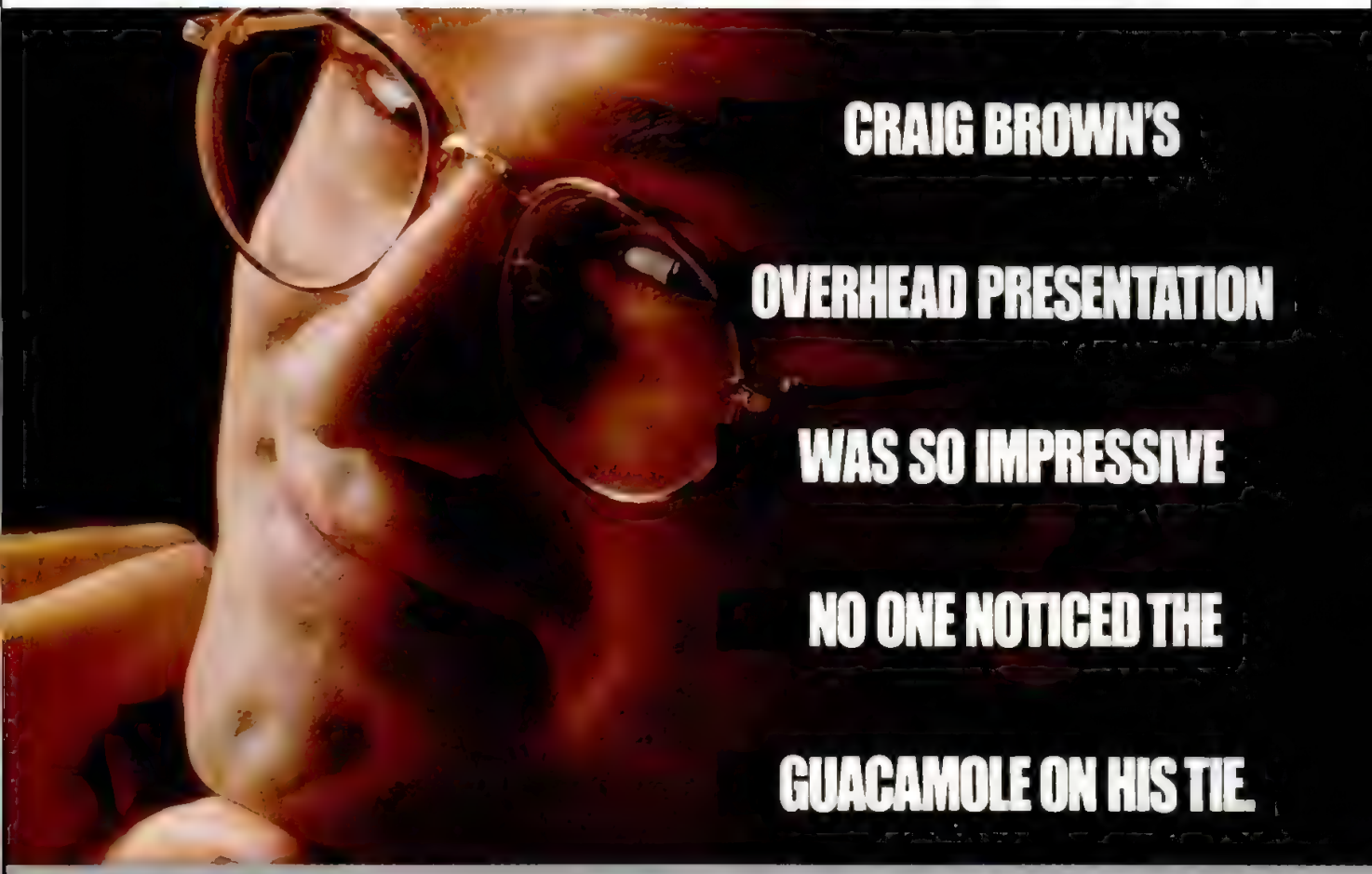
Item costs are tracked by warehouse. Also you can view quantity, unit cost, and extended cost (quantity *x* unit cost) for the last 12 purchases of an item on one handy screen. All of the inventory reports—including the reorder report—can be produced by warehouse. However, you're limited to one costing method for the entire company. Open Systems will handle serialized inventory but will not track lots.

Open Systems does a good job of supporting physical inventories by freezing inventory during physical counts and using count tags. Open Systems doesn't currently support kitting or include a Bill of Materials. However, Open Systems should have released a Bill of Materials module by the time you read this.

REPORTING

The package provides a wealth of standard reports. A nice enhancement, however, would be the use of wildcards when entering reporting fields.

Building financial reports consists of creating a statement layout file and a statement content file. The statement layout defines the report columns, and the content file defines the report rows. To print a statement, you simply indicate which layout and content files to use. The ability to mix and match rows with



columns minimizes the time it takes to create and maintain multiple financial statement formats.

The report writer module should be able to handle all but the most complex reporting requirements. It can report on data residing in any module in the system, with no programming required. However, you'll need to have an understanding of the file structure. Open Systems plans to introduce an EIS module by the end of the year.

CUSTOMIZATION AND IMPLEMENTATION

Providing source code has long been a tradition with this product. Hence the name: Open Systems. The package is written in BBx, a version of BASIC that runs uncompiled. As a result, one of the product's greatest strengths is the large number of third-party products and developers that work with and develop for it. If the standard Open Systems product is missing a feature or two, it's likely that some developer has already filled the gap.

Not all changes require customizing source code, though. Open Systems' Resource Manager enables you to modify menus, lookup windows, and help screens. Of course, this feature would be even better if it allowed you to make such changes specific to each user.

System security is straightforward. You assign each user or group a password (called an "access code" in Open Systems vernacular) and define the menu options they can access.

Open Systems may not be the package for you if network performance is vital. It finished at or near the bottom on every performance test we ran. Although Open Systems offers neither the most features nor the best performance, it does offer a good track record and solid functionality, particularly in the areas of inventory and order management.

SUITABILITY TO TASK

Platinum

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	●
Managing orders and inventory	●	●	●	○
Reporting	●	●	●	●
Customization and implementation	●	●	●	○
Auditing and securing data	●	●	●	●

Platinum Software Corp.

Platinum

BY LUCIANO MEROCCHI & MICHAEL DIXON

Platinum, Version 3.0, from Platinum Software Corp. is a truly international accounting product offering intercompany processing, foreign currency translation, and consolidations. Like breaking a wild mustang, harnessing the power of this animal requires experience, skill, and strategy.

Platinum's Premier Ledger retails for $10,000 and includes Premier FRx, the financial report writer. Other Premier modules—intercompany processing, foreign currency translation, and premier consolidation—range from

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FEATURES HIGHLIGHTS

LAN-Based Accounting

LAN-based accounting systems are complex, feature-laden software packages, and this year's crop has more features than ever before—so many, in fact, that we have room in the magazine to publish only the highlights, this year's hot-button features. We urge you,

Products listed in alphabetical order

■ = YES □ = NO

	PC MAGAZINE EDITORS' CHOICE Accounting	AccPac Plus Vision/32	Great Plains	Impact Award Accounting
Record manager	Btrieve	C-ISAM	Btrieve	Btrieve, ISAM
Customization				
Macro facility	■	■	■	■
Separate custom menu for each user	■	■	■	■
Change data entry screen field names	■	□	□	■
Define custom lookup windows	■	■	□	□
Source code available	□	□	□	■
General Ledger				
Maximum account size, number of segments	25, 25	12, 2	11, 15	15, 15
Number of prior years' history	Unlimited	1	Unlimited	Unlimited
Maximum number of budgets per account per period	4	1	Unlimited	10
Statistical accounts	■	□	□	■
Intercompany postings	■	□	□	■
Multiple retained earnings accounts	□	■	■	□
Multicurrency conversions	■	■	□	■
FASB-52–compliant multicurrency consolidations	□	■	□	□
Performs allocations	■	■	■	■
Accounts Payable				
Vendor number length (alphanumeric characters)	20	6	7	7
Flags 1099 form by line item	□	□	■	□
Customizes checks	■	■	■	■
Allows posting of intercompany vouchers	■	□	□	■
Accounts Receivable				
Customer number length	20	6	7	7
Calculates commissions based on gross profit/payments received	■■	■□	■■	■■
Multicurrency transactions	■	■	□	■
Order Entry				
Order by customer's part number	□	□	□	■
Creates custom-configured items on the fly	□	□	■	■
Kitting	■	■	■	■
Tracks request date at line item	□	□	■	■
Calculates multilevel taxation	■	■	■	■
Handles drop shipments	■	■	■	■
Multicurrency transactions	□	□	□	■
Inventory				
Item code length	20	16	15	15
Maximum number of levels in bill of materials	80	1	1	15
Defines costing method at item level	■	■	□	□
Tracks unit cost by stocking location	■	□	■	■
Reorder report by warehouse	■	■	□	■
Inventory costing method: average/standard/last	■■■	■■■	■■■	■■■
Maximum number of layers for FIFO	Unlimited	5	Unlimited	Unlimited
Tracks serial numbers/lot numbers	■■	■□	■□	■■
Price by customer class/product class	■■	■■	■■	■■
Slow-moving and obsolete report	■	■	■	■
Purchase Order				
Processes material requisitions	■	■	■	■
Creates purchase orders automatically from reorder information	■	■	■	■
Multicurrency transactions	□	□	□	■

* This feature is available through modification of the source code

however, to access the full summary of features in Library 3 (Features-Software) of the PC Magazine Editorial Forum on ZiffNet. Type Go ZNT:EDITOR at any ZiffNet or CompuServe ! prompt; search on keywords.

Macola Progression	MICA IV	Open Systems Accounting	Platinum	RealWorld Accounting	SBT Professional Series	Solomon III
PC MAGAZINE EDITORS' CHOICE			PC MAGAZINE EDITORS' CHOICE			
Btrieve, ISAM	Btrieve	BBx	Btrieve	Btrieve, ISAM	FoxPro	MDBS
■	□	□	■	□	■	■
□	■	□	■	■	■	□
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■	□	■	□	■	■	□
15, 3	11, 4	12, 4	32, 30	8, 8	24, 6	12, 2
99	1	1	Unlimited	1	Unlimited	99
99	1	1	99	1	Unlimited	3
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15	16	20	18	15	15	15
11	40	9	1	1	N/A	5
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■	■	■	■	■	■	□
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Unlimited	3	12	Unlimited	Unlimited	Unlimited	Unlimited
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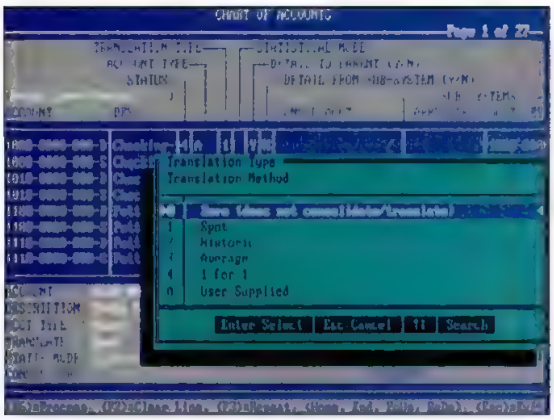

Platinum's powerful Foreign Currency Manager captures the translation type by individual account.

$4,000 to $12,000. Other core modules range from $995 to $1,595. If you don't need the features of the Premier modules, you can purchase the significantly less capable standard G/L for $995.

In order to address the requirements of multinational corporations, Premier Ledger supports a 32-character account code with user-defined account segments. The chart of accounts can be generated by combining account segments based on user criteria.

Another feature, historically found only on larger systems, is the ability to post and retain unlimited budget, statistical, and actual data for an unlimited number of past, current, and future periods. Oddly, Platinum provides little on-line account-analysis capability, making it difficult to get at this data.

All input to the Premier ledger is time-, date-, and user-stamped. Eventually, when this feature is incorporated in all of the core modules, it will be considered invaluable for reviewing and tracking all changes that have been made to master-file data.

FOREIGN FLAVOR

Platinum features a strong Foreign Currency Manager, which allows the processing of multiple currency transactions and lends the software an air of international savoir faire. Rates can be static or input daily, with different buy and sell rates for an unlimited number of foreign currencies. The system will calculate the unrealized exchange gain or loss at the end of the period based on predefined thresholds.

Transactions are stored in both the natural and home currency and can be reported in either form, fully compliant with FASB 52. Field sizes have also been modified to accommodate such currencies as the Italian lira and the Japanese yen. This has the added benefit of allowing dollar transactions to extend to $999 trillion. To complement the international flavor, Platinum offers six foreign-language versions, which are defined on a user-by-user basis.

INVENTORY AND ORDERS

Although Premier Ledger is a marvelous first step in addressing the financial requirements of large companies, Platinum has some shortcomings in its inventory and order management functions. One of the most serious is that the integration between inventory and G/L is based on a net change in inventory value instead of being based on transactions.

Other weaknesses exist, including the inability to split commissions on sales, set contract pricing, freeze inventory for physicals, manage blanket orders, define cost of sales accounts on invoices, or allow specific identification costing for serial/lot tracked items.

FACT FILE

EDITORS' CHOICE

Platinum, Version 3.0

Platinum Software Corp., 15615 Alton Pkwy., Irvine, CA 92718; 800-999-1809; fax, 714-727-1255

List price: $995 per module; System Manager, $195; 3-user module, $1,195; each additional 3-user module, $395

Requires: Server: 640K RAM, 40MB hard disk space, any DOS-NetBIOS-compatible system. Workstation: 640K RAM, DOS 3.2 or later.

In short: With extras like the Premier Ledger, Platinum 3.0 offers a truly comprehensive accounting package worthy of serious consideration by large companies. Be ready, though: Lots of skill and experience are needed to get the program off and running.

500 ON READER SERVICE CARD

Recognizing this, representatives at Platinum Software have noted that they plan to enhance the inventory module in its next version. We are told it will be transaction-based and offer user-definable transaction types. Other expected changes include improvements in LIFO/FIFO costing, physical inventory processing, and integration to the Premier Ledger.

REPORTING

The Premier FRx uses a building block approach to financial reporting, with separate row, column, and tree definitions that are grouped together and saved into a report catalog. Row and column definitions have the look and feel of a spreadsheet, including the use of the forward slash to access the menu. Complex calculations, including the use of IF, THEN, ELSE conditions, can be defined in rows and/or columns to generate management reports. This level of functionality is extremely useful for creating reports such as statements of changes in financial position.

A single report can incorporate data from multiple company databases, multiple fiscal years, and spreadsheets, providing unlimited flexibility. As many as 400 reporting trees can be created by defining up to 10 levels, which link to specified characters in the chart of accounts. This capability allows users to create endless corporate reporting hierarchies regardless of the chart of account structure. For example, if the chart of accounts has not been properly segmented, the corporation will still be able to use multiple trees to report by division, department, cost center, and responsibility.

Reporting outside the Premier Ledger also has a great deal of flexibility thanks to multiple key fields, full DOS wild carding features, and the ability to save report selection criteria as a menu choice. A quantum leap in advanced reporting is available through products like Forest & Trees and Xtrieve. Users can also try Platinum Publisher, a new Windows-based visual database reporting and query tool.

CUSTOMIZATION

As with many other accounting solutions, customization is occasionally required to meet unique user situations. Platinum

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Jay Pancost
IBM Customer Engineer

To IBM Customer Engineer Jay Pancost, going the extra mile often means exactly that. His service calls take him to homes and offices from the Grand Canyon to the Hopi and Navajo reservations. "When you buy a PC," he says, "the company that made it should be there for you when you need them. I like the idea of a job where people are always glad to see me, even if they're sometimes surprised I would go so far off the beaten path." Wherever you may be, there are more than 10,000 IBM service representatives like Jay Pancost, in over 1,600 locations nationwide, at your service. Right where you want them.

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L-R: Alice Robinson, Gregg McGhee, Jeff Herman and Beverly Whitman, Custom Build Technicians, IBM Personal Computer Company

425SX/Si

ValuePoint Si

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- Compact size: 14.2" W x 4.8" H x 16.6" D
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ValuePoint Desktop

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ValuePoint Mini-Tower

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425SX/S

433DX/D

466DX2/T

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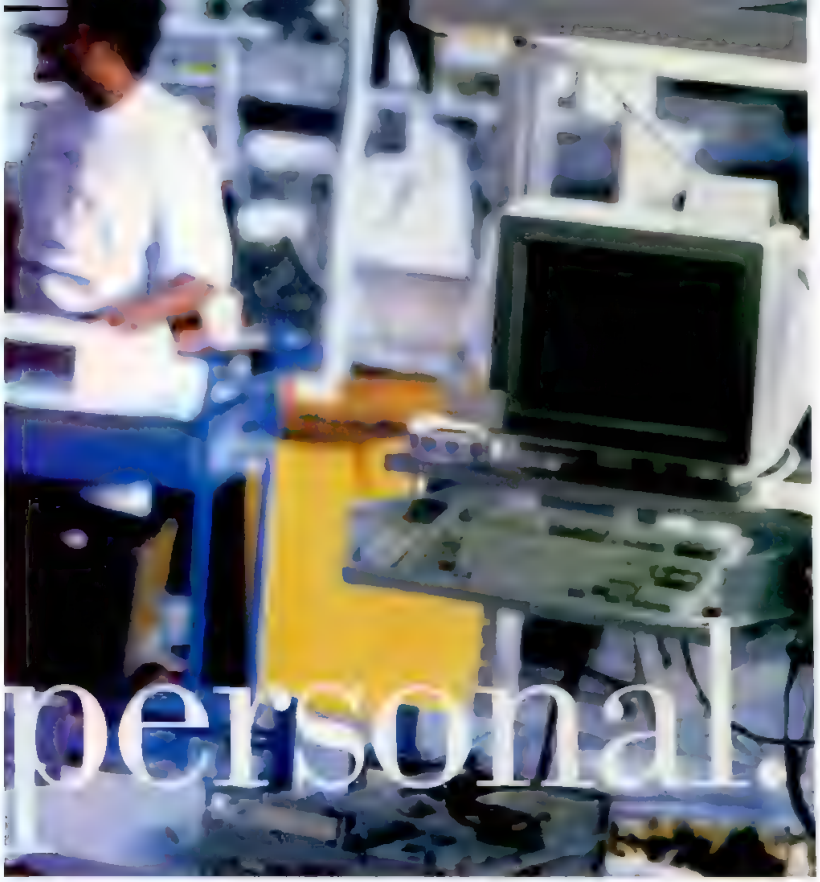

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- Zero Insertion Force (ZIF) socket for fast, easy processor upgrades
- A 32-bit VESA Local Bus slot for local bus speed on SCSI drives and other peripherals
- IBM HelpWare

	ValuePoint Si – NEW!	ValuePoint SpaceSaver	ValuePoint Desktop	ValuePoint Mini-Tower
Features	**425SX/Si**	**425SX/S**	**425SX/D**	**433DX/T**
Processor	i486SX/25MHz	i486SX/25 MHz	i486SX/25 MHz	i486DX/33 MHz
Hard Drive/Memory	120MB/4MB	120MB/4MB	120MB/4MB	340MB/4MB
Diskette	3.5"	3.5"	3.5"	3.5"
Monitor	IBM 14V 14" SVGA NI	IBM 14V 14" SVGA NI	IBM 14V 14" SVGA NI	6318 14" SVGA NI
Operating System	IBM DOS & WINDOWS™	IBM DOS & WINDOWS	IBM DOS & WINDOWS	IBM DOS & WINDOWS
Price* / IBM Credit Lease**	**$1,539** / $56 per month	**$1,649** / $60 per month	**$1,709** / $62 per month	**$2,459** / $89 per month
Features	**425SX/Si**	**433SX/S**	**433DX/D**	**466DX2/T**
Processor	i486SX/25 MHz	i486SX/33 MHz	i486DX/33 MHz	i486DX2/66 MHz
Hard Drive/Memory	212MB/4MB	120MB/4MB	120MB/4MB	527MB/4MB
Diskette	3.5"	3.5"	3.5"	3.5"
Monitor	IBM 14V 14" SVGA NI	IBM 14V 14" SVGA NI	IBM 14V 14" SVGA NI	6319 15" SVGA FS NI
Operating System	IBM DOS & WINDOWS	IBM DOS & WINDOWS	IBM DOS & WINDOWS	IBM DOS & WINDOWS
Price* / IBM Credit Lease**	**$1,699** / $62 per month	**$1,789** / $65 per month	**$2,059** / $74 per month	**$3,319** / $120 per month
Features	**433DX/Si**	**433DX/S**	**466DX2/D**	**466DX2/T**
Processor	i486DX/33 MHz	i486DX/33 MHz	i486DX2/66 MHz	i486DX2/66 MHz
Hard Drive/Memory	212MB/4MB	245MB/8MB	245MB/4MB	527MB/8MB
Diskette	3.5"	3.5"	3.5"	3.5"
Monitor	IBM 14V 14" SVGA NI	IBM 14V 14" SVGA NI	IBM 15V 15" SVGA FS NI	IBM 15V 15" SVGA FS NI
Operating System	IBM DOS & WINDOWS	OS/2®	IBM DOS & WINDOWS	OS/2
Price* / IBM Credit Lease**	**$2,049** / $74 per month	**$2,359** / $85 per month	**$2,729** / $98 per month	**$3,589** / $129 per month

†† ValuePoint Si systems do not include all features listed above chart. Please refer to product details listed at left, or call for more information. ValuePoint Si prices listed reflect IBM Basic Keyboard only. The Enhanced Keyboard is available at additional cost.

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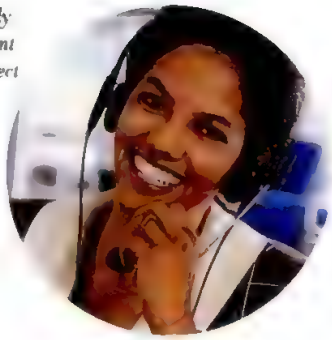

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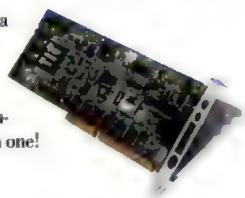

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provides several levels of customization. Using the Resource Manager module, you can customize and add menus and create unlimited zoom windows, all without source code-level programming. Any data field in Platinum can have a separate lookup table defined for it, and the lookup can query any Platinum data file or other customized Btrieve file. If more complex customization is required, you can use a programming tool such as Clipper or Magic PC to create your own screens or even entire applications.

Platinum's ability to deal with foreign currency and unlimited history, combined with its unsurpassed reporting capabilities and ease of customization, make it worthy of serious consideration for large companies migrating to LAN-based financial accounting systems. However, organizations looking at Platinum should also consider the skills and experience required to deal with the many issues relating to implementing such a flexible and robust accounting product.

RealWorld Corp.

RealWorld Accounting

BY SUZANNE COLVIN

RealWorld Accounting, Version 6.5, priced from $795 to $1,195 per module, represents RealWorld Corp.'s effort to continue the tradition of providing quality accounting software to meet the needs of medium-sized businesses. It may, however, represent only a partial success because issues like interface and overall depth have only been partially addressed. In addition to offering the traditional accounting modules, RealWorld—which also runs on Xenix and Unix platforms—offers specialty modules (such as sales lead tracking and professional invoicing) and supports many third-party custom modules.

SUITABILITY TO TASK

RealWorld Accounting

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	○
Managing orders and inventory	●	●	●	○
Reporting	●	●	○	○
Customization and implementation	●	●	●	●
Auditing and securing data	●	●	●	○

FINANCIAL ACCOUNTING

RealWorld's financial accounting modules (G/L, A/P, and A/R) contain all the basic accounting features, including budgeting, bank reconciliation, consolidations, and recurring transactions. However, you won't find many advanced features such as statistical accounts, multiple budgets, multicurrency support, or a sophisticated financial report writer. Furthermore, you can only maintain two years of detailed G/L transactions.

The G/L module contains several handy features to help management make decisions. Its loan calculation and amortization feature, for example, will help make leasing and purchase decisions by computing the principal and interest portions of payments made. RealWorld can prepare cash flow projections based upon open receivables and payables, and display a concise customer history on the screen.

You can attach notes to transactions and item masters, such as G/L accounts, journal entries, customers, invoices, vendors, and purchases. These notes, which are free-form text boxes, can be used to track discussions with customers or vendors, or to log background information on journal entries, orders, or G/L accounts.

On the negative side, RealWorld's user interface shows its age. Keystroke standards are ignored—F1 will scan a file instead of displaying Help text and F8 invokes Help. Also, when you're working on a journal entry, order, or invoice, RealWorld displays only one line item at a time.

ORDER ENTRY & INVENTORY

In general, RealWorld's purchasing, inventory, and order entry modules should meet the needs of most medium-size distributors. Its inventory pricing capabilities are flexible. For example, multiple sales prices can be established for each inventory item and those prices can be discounted by dollar or percentage, based upon the individual customer.

RealWorld shows each purchase order line item on a separate screen. It also uses nonstandard key strokes.

Those prices can also be reduced to "sale" prices during specified date ranges, and permanent price changes are easily made to specific prices or categories of prices.

You can customize shipping and COD labels to meet your shipper's requirements. Work orders can be printed for items requiring assembly. RealWorld's billing terms should meet the needs of most industries. In fact, they can handle "prox" terms (that is, same day of the following month) common in distribution and rental industries.

The are a number of inventory-control specific features in the inventory module. For instance, items must be associated with specific vendors before you enter purchase orders. Also, inventory items must be associated with warehouses before you sell those items. These controls require a little additional set-up time, but they pay off in extra efficiency when the system is operational.

Recognizing that professionals (attorneys, engineers, and CPAs, for example) require significantly different features than those offered in a standard Order Entry Module, RealWorld sells a Professional Time and Billing module and a Professional Invoicing module. Used in tandem, these modules can serve the complete billing and reporting needs of most medium-size professional firms.

REPORTING

RealWorld offers a wide array of reporting options that focus on helping management make decisions. Among the best of these are the open back-order report, the purchase advice report, and the inventory

turn-over report. Unfortunately, some of RealWorld's standard reports do not include historical transactions, such as past months' inventory transactions by period or type. To obtain historical information, you must prepare a custom query using the report-writer module.

Although RealWorld doesn't allow changes to invoice formats without custom programming, the 99 predefined invoicing formats and three standard product invoice formats should suit most needs.

CUSTOMIZATION & IMPLEMENTATION

RealWorld also provides its COBOL source code to end users for customization. However, a better solution for most companies would be to employ one of the many third-party developers who have experience modifying RealWorld software. Third-party offerings include modules for industries such as retail, property management, advertising, and medical. RealWorld's developer's directory describes the available products.

One of the primary enhancements found in Version 6.5 is the ability to run the Btrieve record manager. Btrieve should increase the network performance for larger networks, and also allow myriad third-party tools to access RealWorld data files.

RealWorld's interface comes in two flavors: drop-down menus and traditional multilevel menus. Other applications can also be added to the RealWorld menu system. You can also assign passwords for each menu choice, but not by user. You probably want to use the drop-down menu interface because the traditional interface limits password protection. For example, with the drop-down menu, you can set up separate passwords for entering, printing, and posting general journals. With the traditional interface, you can assign only one password for all of the general journal functions.

Although RealWorld features context-sensitive help, it frequently instructs the user to review the hard-copy manual. Unfortunately, the manuals could use a

FACT FILE

RealWorld Accounting, Version 6.5

RealWorld Corp., 282 Loudon Rd., Concord, NH 03302-2051; 800-678-6336; fax, 603-224-1955

List price: $795 per module; single-user system manager, $295; 8-user system manager, $795.
Requires: Server: 2MB RAM, 2MB hard disk space, LANtastic, NetWare. Workstation: 1MB RAM, DOS 3.3 or later

In short: RealWorld Accounting has a broad feature set and the largest number of third-party software modules of any LAN-based accounting package on the market. Its ability to run on DOS, Unix, and Xenix platforms and its long, stable history appeal to many businesses. However, its user interface and user manuals could stand updating

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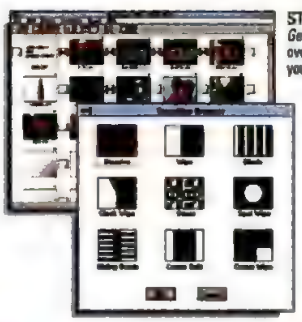

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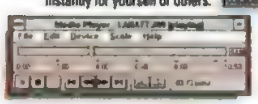

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PC MAGAZINE

Best Product 1992, PC Magazine, January 1992

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facelift; virtually no graphics are provided, and the images of screens and reports are almost too small to read.

Rather than emphasizing end-user support, RealWorld focuses on supporting its resellers and developers, and encourages users to contact them. RealWorld Software offers courses and telephone support to its resellers and developers. For users who cannot locate a local reseller, RealWorld offers subscriptions for unlimited telephone support and updates at a cost of $350 per module, per year.

RealWorld stands head and shoulders above its competitors with its ability to perform field locking in a LAN environment. For example, two users can change the same customer record at the same time, provided they don't modify the same fields.

Though a stable product with a broad range of features and healthy third-party vendor support, RealWorld is sorely in need of a new manual and cries out for a better interface. And considering the leaps forward that other products have made in this category, RealWorld will have a hard time turning any heads.

SBT Accounting Systems

SBT Professional Series

BY ANDREW DONDLINGER

SBT Professional Series, Version 2.5, from SBT Accounting Systems, has many new features such as a flexible G/L account mask, a three-year posting window, and the ability to create custom queries. Built on the FoxPro engine, SBT can be tailored to meet your business requirements both through the use of flexible setup options and modification of source code. SBT offers seven accounting modules including System Manager, G/L, A/P, A/R, Sales Orders, Purchase Orders, and Inventory Control. Prices range from $895 per module for five users to $1,295 for unlimited users and source code. SBT is currently offered for DOS-based LAN environments and, by the time you read this, Windows. A Macintosh version is expected by the end of the year.

SUITABILITY TO TASK

SBT Professional Series

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	○
Managing orders and inventory	●	●	○	○
Reporting	●	●	●	○
Customization and implementation	●	●	●	●
Auditing and securing data	●	●	●	○

FINANCIAL ACCOUNTING

SBT has significantly updated its G/L since our last review. The backbone of the G/L is the user definable account code that can be up to 24 characters with 6 segments. Allocations can be made by percentage or fixed-dollar amount, and you can create unlimited budgets per account per period.

Built on the FoxPro engine, SBT Professional Series can be tailored to meet your business needs through flexible setup options and source code modification.

Account inquiry is one of the G/L's strengths. Not only can you display account balances by period for the year, but you can "drill down" from the balance to the transactions and to the original journal entry. To make a good feature even better, SBT should enable the drill down to display submodule data (for example, A/P Invoice).

SBT plans to add foreign currency capability to its product by the end of the year.

The A/P and A/R modules support unlimited bank accounts and Value Added Tax rates. SBT uses the vendor invoice number, not voucher numbers, to track payables. This may be adequate for smaller companies, but a sequential voucher number offers greater control to larger companies. A bank reconciliation function is included in A/P and interfaces with the A/R and G/L modules.

ORDER MANAGEMENT AND INVENTORY

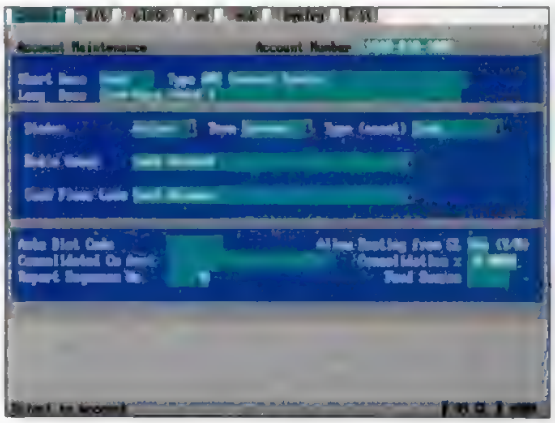
The SBT Sales Order module includes a number of very useful features, but the omission of several critical ones significantly detracts from its overall capabilities.

On the up side, if your company prepares bids to your customers, you can use SBT to enter and track them. Converting the bid to a sales order is done with one keystroke. Notes and memos can be entered per line item with the former printed on the sales order.

If you sell items which have lot or serial numbers that need to be tracked, you can define whether SBT will prompt you for the number during sales order entry or during shipment. SBT will also display a list of available serial/lot numbers on the screen during sales order entry.

On the down side, each customer can be assigned only one ship-to address. To enter another ship-to address during order entry, you must either key in the new name and address each time or enter all ship-to addresses as fictitious customers and select them from the inquiry window. Neither of these approachs is very attractive. SBT Professional Series is unable to handle blanket orders, drop shipments, or kitting.

The inventory module captures up to six screens of information on each inventory item. With its wonderful inquiry capability, this module becomes an excellent tool for managing inventory. Not only can you track items at multiple warehouses, but also at multiple bin and store locations within a warehouse. One notice-



The SBT Professional Series G/L includes a user-defined account format, multi-company consolidations, and simplified ratio analysis.

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FACT FILE

SBT Professional Series, Version 2.5

SBT Accounting Systems, One Harbor Dr., Sausalito, CA 94965; 800-944-1000; fax, 415-331-1951

List price: $895 for 5-user module; each additional 5 users, $895

Requires: Server: 486 processor, 8MB RAM, 20MB hard disk space, NetWare, LAN Manager Workstation. 386 processor, 8MB RAM, DOS 5.0 or later.

In short: SBT Professional Series has broken into the ranks of high-end accounting with excellent features that are backed by a strong complement of vertical products and the ability to completely customize the package.

509 ON READER SERVICE CARD

able omission is the inability to assign item cost by location.

REPORTING

SBT's standard reports are comprehensive and flexible. Each report provides numerous selection options and you can output the reports to screen, printer, or file. One disappointment is that lookups and wildcarding are available for G/L reports only.

Management will love the Business Status Report. This report, which can also be displayed and updated at user-specified intervals, provides a snapshot of key business indicators. It lists current and period-to-date A/R and A/P balances, open sales orders, open purchase orders, and current inventory value.

SBT provides numerous standard financial reports whose formats are derived from the type codes assigned during chart of account setup. If you require a more sophisticated report writer, third-party products like R&R Report Writer (Concentric Data Systems, 800-325-9035) should be explored.

CUSTOMIZATION

SBT is written using Microsoft's FoxPro, an extension of the popular dBASE standard. Source code is provided to end-users for an additional $400 per module.

As you would expect, there is a multitude of available third-party developers and products. Because of the relative ease of FoxPro development, businesses should be careful to select only experienced, qualified companies (or in-house resources) to perform source code modifications.

You can tailor the software without changing source code by creating custom menus to access non-SBT programs, user-specific browse windows, user-specific hotkeys, and validation rules for certain fields. With the appropriate password, FoxPro experts can access FoxPro commands from the main menu.

SBT Professional Series' Business Status Report, which can be updated at user-specified intervals, provides a snapshot of key business indicators.

SECURITY AND IMPLEMENTATION

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CIRCLE 067 ON READER SERVICE CARD

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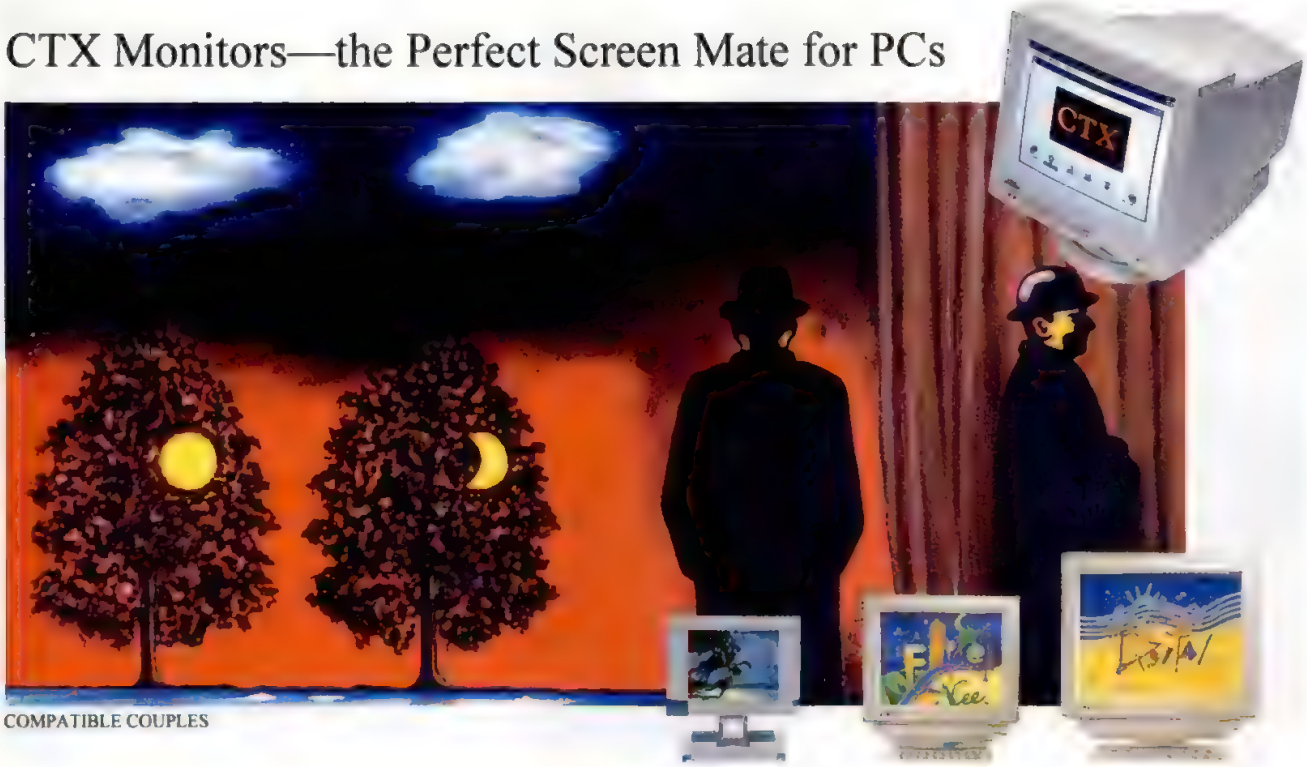

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Size	14"	14"	14"	15"FST	17"FST	17"FST	9.4"TFT Color LCD Monitor
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Resolution	800x600/72Hz 1024x768/60Hz	800x600/72Hz 1024x768/60Hz	1024x768/70Hz	1024x768/70Hz	1024x768/70Hz 1280x1024/60Hz	1280x1024(NI)	640x480/60Hz
Flicker Free	800x600/72Hz	800x600/72Hz	Yes	Yes	Yes	Yes	Yes
Low Radiation	Optional	Optional	Optional	Optional	Yes	Yes	Non Radiation
Full Screen	Non	Yes	Yes	Yes	Yes	Yes	Yes
Digital	Non	Non	Non	Option (1560)	Yes	Yes	Yes

*Model 1785LR will be available in Nov.,1993

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CIRCLE 329 ON READER SERVICE CARD

Solomon Software

Solomon III

BY SUZANNE COLVIN

New customization tools combined with a strong basic feature set make Solomon III, Version 8.0, a powerful and flexible management accounting tool. Since our last review in 1991, Solomon Software has added over 200 features to Solomon, including SolomoNotes, an exciting new customization module that can dramatically extend Solomon's standard capabilities. Solomon retails for $795 per module.

ESTABLISHED STRENGTHS

Though strong financial reporting, well laid-out screens, and strict accounting controls have been Solomon's trademarks, Version 8.0 breaks new ground. Among its enhancements is a new feature that lets you automatically allocate expenses among departments by fixed percentage, by units, or in proportion to the expense totals for another account.

Solomon III has added SolomoNotes, an exciting new customization module that dramatically extends Solomon's standard capabilities.

Although most will find Solomon's financial accounting modules more than adequate, some high-end features are missing, including foreign currency capability, a user-definable account structure, and full on-line account analysis. Solomon IV Windows, however, an entirely new product to be released by the end of the year, should feature these capabilities.

SUITABILITY TO TASK

Solomon III

	POOR	FAIR	GOOD	EXCELLENT
Financial accounting	●	●	●	○
Managing orders and inventory	●	●	●	○
Reporting	●	●	●	○
Customization and implementation	●	●	●	●
Auditing and securing data	●	●	●	●

MANAGING ORDERS & INVENTORY

Solomon's order entry and inventory modules are geared primarily for distribution companies. The product doesn't include sales forecasting, material requirements planning, shop floor control, or physical inventory count tracking capabilities. However, Solomon does have relationships with third-party developers that can add relatively seamless manufacturing capabilities.

Solomon can track inventory by warehouse, manage kits with up to five levels, and suggest substitutions for out-of-stock

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CIRCLE 855 ON READER SERVICE CARD

Solomon III's order entry screen summarizes the entire order, and utilizes grey drop-down areas to show details.

items. In addition, Solomon checks customer credit levels during order processing and allows you to assign special pricing levels to each customer using discount prices or rates based upon purchase volume.

Most notably absent from the inventory module are the ability to perform split commissions, to indicate order date and ship date at the line item, or to freeze inventory during physical inventories or support cycle counting. Although Solomon representatives say many of these holes can be patched up by developing custom SolomoNotes applications, having these features as part of the base software is preferable.

With its rock-solid financial modules, strong controls, quality reporting, and the addition of SolomoNotes, Solomon is great for many medium-size businesses.

CUSTOMIZATION AND IMPLEMENTATION

Prior to SolomoNotes, customization was complex and cumbersome. Now, you can easily add data fields, security features, or custom screens to any Solomon field or screen without modifying source code. SolomoNotes doesn't allow changes to existing Solomon screens, but rather lets you to add secondary screens that can be accessed during data entry. For example, you can design a template for credit and collection data and trigger the screen to pop up during order entry if the customer is over his or her credit limit. Or you can design templates to track the reasons for inventory inspection rejects or customer returns. You can even use SolomoNotes to add templates that assign multiple salespeople to each order line item.

Because no source code is modified, SolomoNotes templates won't need to be changed when you upgrade Solomon.

In addition to SolomoNotes, Solomon offers a flexible macro facility, SolomonScript, and the Customization Toolkit, a set of tools to modify standard screens and forms. Further, Solomon allows the import and export of data files.

REPORTING

Solomon's standard reporting capabilities are generally good. Solomon continues its tradition of letting you apply wildcards and masks on key reporting fields. If the data you're looking for isn't available on a standard report, you can develop a custom report using Solomon's Report and Graph Designer module (RGD). Based on the popular IQ report writer, RGD enables users to extract and report on virtually any Solomon data. If you're willing to invest some time to learn this report writer and master Solomon's data file layouts, you'll find it to be a valuable tool.

The financial report writer enables you to easily print financial statements in total, by company, by division (through the use of wildcards), and by period, quarter, or year.

SECURITY AND AUDITING

Solomon's user security features are strong, as well. Each user can be assigned unique password and menu-access rights. Passwords can also be assigned to SolomoNotes fields or certain Solomon processes.

Overall, you'll find good financial audit trail features and controls. All transactions are associated with a user, and transaction detail can be maintained for 99 periods. Security auditing could be improved, however, by adding standard user-activity reports.

Solomon's data security features are nothing less than outstanding. With its built-in fault tolerance capabilities, you can reboot your machine in the middle of a posting and when you re-enter Solomon, the system will restart the posting from the point where it stopped without any data loss.

In the past, Solomon has required a node on the network to be dedicated as a database server. Solomon now offers a NetWare NLM version of the MDBS database, eliminating the need for a dedicated PC, and offering significant performance improvements as borne out by Solomon's improved performance test results.

Solomon offers several levels of support, ranging from a 900 number to guaranteed one-hour service. Solomon Software also offers one telephone call with no time limit when you purchase the software. You can also purchase additional support from a VAR.

With the introduction of SolomoNotes and the NLM database server, Solomon has significantly improved the flexibility and performance of its flagship product. In addition, its rock-solid financial modules, strong controls, and quality reporting make Solomon a great fit for many medium-size businesses. □

FACT FILE

Solomon III, Version 8.0
Solomon Software, 1218 Commerce Pkwy., Box 414, Findlay, OH 45839; 419-424-0422; 800-879-0444; fax, 419-424-3400

List price: $795 per module; Job Costing module, $495; Windows system manager, $195; 3-user module, $1,295.
Requires: Server: 8MB RAM, 23MB hard disk space, DOS 5.0 or later, NetWare 3.1. Workstation: 640K RAM
In short: With more than 200 new features, including SolomoNotes (a new customization module), Solomon III is more flexible and powerful than ever. Solomon IV Windows is due out by the end of the year.
510 ON READER SERVICE CARD

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BEST OF BYTE COMDEX Spring 93

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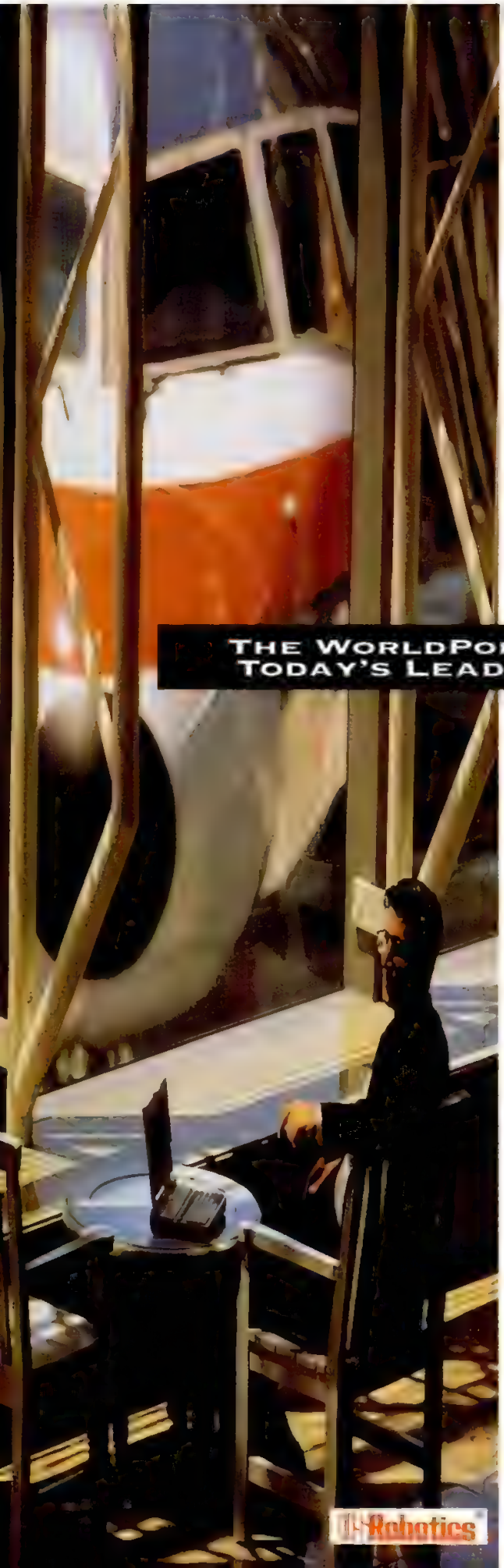

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CIRCLE 920 ON READER SERVICE CARD

NETWORK OPERATING SYSTEMS

Playing The Odds

Deciding on a NOS can seem like you're laying down chips on a game of chance. So make sure the ante and the odds are right for you before you make your choice.

by Gary Gunnerson

You step out of the darkness. Lights flash. Bells ring. Smoke wafts your way. You stand perfectly still, breathing quickly, as others rush to play their favorite games of chance. The feel of fresh currency urges you forward. It's your turn to buy a network operating system (NOS).

Choosing a NOS can seem like part blind luck, part mysticism—just like the feeling when you step into a casino. The sights, sounds, and smells overwhelm the neophyte, while those with seasoned senses stride purposefully toward the familiar. The NOS newcomer must learn the rules of each network offering and discover which vendor requires the steep ante, which game is most likely to pay off at high odds, and which best suits the situation.

NOS gamblers come in different sizes, statures, and preferences. Whether you've just decided to

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Photography by Scott Peterson

HIGHLIGHTS

Network Operating Systems

NETWORK OPERATING SYSTEM software has come a long way since the days when you had to worry about which topologies each package supported. Today we see that some of the early entrants in the field are showing their age; others have grown into strong, reliable packages, and some of the newer, more complex packages are still maturing.

A NOS IS A COMPLEX piece of software to begin with, but it should communicate its power, flexibility, and capability through a clear, consistent interface and documentation. A NOS should be reliable and provide good management utilities and security.

NETWORKS TEND TO GROW. You start out with a few key people connected, then everybody wants in, then you get e-mail, then you acquire another company or your business changes in some way. Unless you're absolutely certain your network will remain as it is, you should choose a NOS that is likely to grow with your networking needs.

BEFORE CHOOSING A NOS, you need to figure out more than simply what kind of clients and resources you need to support. Are you sure that you'll only be sharing files and printers? Is good Mac support critical? Do you need multiple protocol support on a single server? Is support for huge client/server databases a must? What about wide-area connectivity, C2-level security, and a global naming and directory service? How important is server fault tolerance? Will your company be investing in servers with multiple processors? Will Windows NT be on most of the desktops in your firm in a year?

THIS ROUNDUP encompasses a range of NOS solutions—from LAN Manager and NetWare 2.2, either of which will still run on an AT-class machine; to OS/2 LAN Server, with power but a questionable interface; to the functional, dependable, ubiquitous NetWare 3.11; to the undeniable VINES, with its stellar StreetTalk directory services; and finally to the new NOSs on the block: NetWare 4.0 and Microsoft Windows NT with Advanced Server, two very different networking solutions. NetWare 4.0 delivers a hierarchical directory service and advanced server management features. Advanced Server, with its out-of-the-box capability for symmetrical multiprocessing and great support for the client/server data model, also meets the needs of many networking sites and builds on the strength of Windows on the desktop.

move up into the server-based networking realm or you've been there for a while and you're shopping for a new "game," you've come to the right place. We've focused here on seven NOSs that support multiple dedicated-server configurations: some just do the basics, but do them well, and some offer the capacity to grow into connection platforms for large enterprises with thousands of clients. Concentrating on mainstream, PC-based NOSs, we evaluated Microsoft LAN Manager, Version 2.2, and Microsoft Windows NT with Advanced Server; Novell NetWare, Versions 2.2, 3.11, and 4.0; IBM Corp.'s OS/2 LAN Server, Version 3.0; and Banyan Systems' VINES, Version 5.52(5). (Digital Equipment Corp.'s Pathworks was in major revision.)

The basic server-client model on which all of these packages are based simply works. You could say this is the 90s version of the mainframe–dumb terminal model—but all jazzed up with 486 clients and servers that are far more manageable (and affordable) than their predecessors. Even many peer-to-peer LANs gravitate to a dedicated server arrangement fairly quickly (in traditional peer-to-peer, each machine can be a server). The biggest problem with peer-to-peer LANs is that they sit on top of DOS, using precious memory. Most organizations end up dedicating a machine to file service to ensure resource availability. True peer-to-peer LANs make sense for very small groups of fairly autonomous workers.

The requirements of a NOS player looking for a multiserver solution range from those of a small workgroup to those of a worldwide enterprise. Administrators with small needs who project little or no growth can just pick one of the market leaders without concern for long-term objectives and get running with good odds for beginner's luck. But one thing you discover quickly when you start connecting PC users is that *networks tend to grow.* Thus, we looked at expansion capabilities among the packages from the position of the folks who have to make it happen: the LAN administrators.

WHAT'S AT STAKE

Most businesses will choose among these offerings with consideration for many elements in their decision matrix. If, for example, your company's offices are in one location, NetWare 3.11 will offer good performance, depending on your applica-

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tions. A geographically dispersed company, on the other hand, with many distributed small or large groups would be better served by VINES or NetWare 4.0, which excel by providing distributed naming and directory services, routing within file servers, and better wide-area network support. If your office is not too big and you have a heavy Mac-DOS mix, Advanced Server is a good bet (especially at its introductory price).

Your existing equipment can also steer you to the appropriate solution. If you need to run your server on an AT-class 286 machine, then look to LAN Manager or NetWare 2.2. These two are the only NOSs here that will run on a 286 platform.

We reviewed each NOS from the perspective of a LAN administrator. What do each vendor and product deliver to help with the weighty, complex task of installing, managing, and maintaining a mission-critical network? In our testing, we followed this growth scheme by installing a first server, then expanding to a two-server environment, then adding a third server across a local bridge (see "What the Numbers Mean").

In our reviewing, we found LAN Manager and NetWare 2.2 at the bottom of the stack in our benchmark tests and features lists. These packages are both showing their age. Unless you need a 286 solution, neither of these two makes sense for a new LAN installation.

NetWare 3.11 remains a stable, efficient, reasonably priced NOS for medium-size networks—although it lacks an integrated naming service (which allows you to log on once to the network rather than to each server). All things considered, this product makes the most sense today as a general-purpose file server with DOS, Windows, Macintosh, and Unix NFS support. If you've already got a NetWare 3.11 installation that's running well, but you want an integrated global directory service, Banyan offers a solution in its Enterprise Naming Service (ENS). ENS essentially delivers Banyan's venerable StreetTalk directory services to NetWare 3.11 (and 2.2) networks.

LAN Server seems to be IBM's latest solution for networking and makes sense if you like OS/2 2.*x*. IBM, however, also continues to market NetWare in non-OS/2 shops. IBM added Macintosh support to its latest release and recently included the option of NetWare or OS/2 on the same server.

Microsoft's Advanced Server looks like it will work well as a high-end multi-CPU applications server for networks that are built with a predominantly client-server architecture. It also makes great sense for mixed DOS-Macintosh shops. Lack of NFS for Unix workstations keeps Advanced Server out of the general file-server category support for the many shops that support Unix. Support for Windows for Workgroups, LAN Manager, and other Windows NT workstations keeps the promise of Windows everywhere alive. This first-version product certainly merits watching.

Banyan's VINES, known for its StreetTalk directory services, is a strong distributed product that has long been aimed at networks requiring global, wide-area connectivity. Its performance sometimes suffers from its Unix underpinnings, but its administrative tools are very good, and Banyan itself is becoming

PC MAGAZINE ▶ EDITORS' CHOICE

• NetWare, Version 3.11

LAN administrators like software bells and whistles as much as anybody, but what really turns them on is something that *works*. This is particularly so for the one piece of software they put most of their chips on: their network operating system.

It's simple. If you're responsible for keeping a network of any size online to sustain a business, you'd better have one you can get up and running without difficulty, that you can manage easily, and, most importantly, that you can count on to keep running through just about anything.

NetWare 3.11 works—and it has for a long time. But even that wouldn't be enough if it didn't deliver good features, functionality, speed, security, scalability—and excellent add-on reliability—for a remarkable range of networking situations. A few of the other products in this article have been around as long or longer, but some have not evolved well. The latest entries in this field bring compelling new capabilities, but it takes some time to shake out the bugs—to reach the stable kind of reliability that NetWare 3.11 offers.

Like all Novell products, NetWare 3.11 is not cheap, but it is well-priced for what it delivers; in addition, Novell is a stable company, and NetWare 3.11's third-party support is legendary. With good multiprotocol support out of the box—IPX/SPX and TCP/IP—and support for NFS, AppleTalk, and OSI available, NetWare 3.11 answers interoperability concerns. And System Fault Tolerance III (SFT III) gives you complete server fault tolerance; the price may seem steep—but not compared to what could happen without this kind of safety net in place. No other NOS offers such a solution.

You also have add-on choices for resolving the lack of native distributed directory services. Novell's own NetWare Naming Service gives some relief by enabling administrators to situate servers in domains. For a more robust approach, albeit one that involves working with two vendors on your NOS, Banyan's ENS for NetWare delivers the structure of Banyan's StreetTalk global directory service to Novell networks. (If you're wondering why you would buy NetWare 3.11, only to supplement it with one of these naming services, then you probably should already be considering NetWare 4.0 or VINES.)

more responsive to its customers. Banyan's ENS may bring a unifying StreetTalk umbrella to mixed NOS shops.

NetWare 4.0 is a first-version product to watch. Already, fixes are out for the new distributed NetWare Directory Services (NDS) in the 4.01 code. The other features that NetWare 4.0 brings to the table—automatic file compression and file migration (which both automate facilities for server-resources management), support for 1,000 network connections, and Windows-based management tools—may prove hard to resist, especially for first-time buyers. Veteran NetWare 3.*x* users should watch 4.*x* as it matures to stability.

So which game will you play? The odds of a NOS's acceptance are set at the first installation. Any trouble at this point to produce winnings in the form of a working server within a reasonable time can discourage the installer from continuing with the same game. Moreover, installing a NOS involves more than just getting a server running. Prospective buyers need a vendor that supports the existing investment in client desktop, interconnect, and server equipment, and that addresses other considerations as well.

Routers, bridges, and gateways are considerable capital investments, and interoperability with these is important. If you're tired of swapping dozens of floppy disks at installation and of flipping through endless documentation, look to Advanced Server or NetWare 4.0, which both ship on CD-ROM, with all documents on-line and searchable.

Binding networking protocols to network adapter cards remains a critical function that must work to create a viable server. NetWare 2.2 continues to require a complete recompile of the OS to perform work at this level. NetWare 3.11 and NetWare 4.0 allow dynamic binding and unbinding of protocols at the system console without bringing the server down.

The other NOSs require an installation procedure and a reboot of the server to make binding changes take effect (most corporate users perform these procedures in off-hours). Advanced Server makes the job pleasant with its visual "light bulbs" in the services dialog box.

Once the file server attaches to the LAN, the installer then creates applications directories, user accounts, and printing resources. This process can be complicated by the directory services implicit within the OS. Flat directory structures such as those with VINES or Advanced Server make it easier, whereas the hierarchical design and restrictive file-level rights inherent to NetWare 4.0 require a good understanding of an enterprise's directory structure. A LAN installer also must understand the underlying OS to perform these steps appropriately, because file rights vary with each NOS, as do the rights implied by hierarchical directory structures.

If you prefer a graphical interface, those built into Advanced Server and NetWare 4.0 could make installation easier. However, a consistent character-based interface (such as Netware's C-Worthy) works equally well. Moreover, a good interface does make a difference: The power and flexibility of LAN Server is at times obscured by its unclear or inconsistent interface and documentation.

SUPPORTING YOUR CLIENTELE

Most companies maintain a heterogeneous mix of client systems, including DOS, Windows, Macintosh, OS/2, Windows NT, and Unix workstations. In today's environment, a homogeneous NOS serves as the unifying agent. Transparent access to server resources provides the best support for clients. Network printers, for example, should appear in the same places as local printers.

Shared network volumes should also appear as if by magic as extensions to the local client. All the NOSs reviewed do this well for DOS, Windows, OS/2, and Macintosh clients. NetWare 3.11 and 4.0 also excel at providing transparent Unix and Open Systems Interconnection (OSI) access through additional file systems—NFS (Network File System) and FTAM (File Transfer and Access Method) modules—respectively.

Getting a single PC client to talk to several NOS servers requires the client to support multiple simultaneous communications protocols. Three different methods are available on DOS and Windows machines. IBM, Microsoft, and Banyan favor the Network Device Interface Specification (NDIS) drivers, whereas Novell supports its own Open Data-link Interconnect (ODI) specifica-

Suitability to Task: Network Operating Systems

Undoubtedly the biggest piece of good fortune that can be visited upon you in the NOS game comes as you *choose* the right operating system for your business. If you choose well, taking into account what you know of the vendors' "house rules" and the odds, you'll be a great deal more likely to win in the end with an effective network full of happy users. We assessed these NOSs from the perspective of an administrator for their suitability to the task of servicing four increasingly complex networking sites. Now let's lay the cards on the table.

A **small network,** for comparison here, was considered to be one with 50 or fewer clients. Typically the users do lots of sharing and printing of files, so those services should be well executed. Ease of installation and configuration is important, as the site is more than likely to be a small business without a lot of capital to spend on the network itself, let alone a consultant to install it. This is often the first network installation for the LAN installer/administrator, perhaps with no training; thus, a clear, consistent interface and good documentation are key criteria. The cost of installing a NOS at this level must be defensible. Therefore, for small networks we weighted price as 40 percent of the purchase decision.

A **medium network,** estimated here at upwards of 100 users, is probably slightly less price-sensitive than a small network. Here, we allotted 35 percent to price in our purchase-decision weightings. Like a small network, such an installation requires file and print services, but these are even more likely to be spread across multiple servers. A site this size might also need support for Macintoshes, which are likely to be sprinkled in—and for the inevitable e-mail.

SUITABILITY TO TASK

Product Name

	POOR	FAIR	GOOD	EXCELLENT
Small network	●	○	○	○
Medium network	●	●	○	○
Medium to large network	●	●	●	○
Large enterprise network	●	●	●	●

tion. A third alternative is the Crynwr (formerly Clarkson) packet-driver specification. Server communications protocols rest atop these device drivers, enabling further client code to provide the image of DOS file and print services.

File and print services derive from a client's native OS, whereas communications transport protocols are determined by specific hosts. Some file services and their native OSs include FAT (DOS), HPFS (OS/2), NTFS (NT), NFS (Unix), and AFP (Macintosh). Protocols required by host OSs include NetBEUI for LAN Server, LAN Manager, and Advanced Server; IPX/SPX for NetWare; and TCP/IP for VINES and Unix.

RUNNING THE THING

The cost of hardware and NOS software remains but a small portion of the lifecycle costs of a network. Other expense items include administering user accounts; adding, moving, and deleting clients; maintaining the LAN infrastructure; upgrading servers; and training.

Most NOS vendors leave the client and LAN infrastructure management to third parties. However, as the Simple Network Management Protocol (SNMP) garners increasing support, most NOS vendors will include SNMP alarm reporting. Traditionally, SNMP clients only talked to intelligent hubs, bridges, and routers; adding the server to the mix decreases the number of management consoles involved in tracking the network.

A server-management console should, at the very least, give the administrator a peek at memory-pool usage, disk utilization, CPU utilization, and communications packet traffic. Advanced Server uses the NT Performance Monitor to track and chart these events in real time. Unfortunately no direct comparison can be made across NOS vendors regarding utilization since each uses different algorithms for reporting these statistics.

See our sidebar on Digital's new Pathworks 5.0 client module, which offers a glimpse at unifying a networking console by providing a universal NOS manager. This module allows you to manage all of your servers from the same machine, regardless of what NOS is set up on the server.

All of the reviewed NOSs support logon passwords with varying levels of user identification and password security to authenticate and grant access rights to shared server resources. With both Windows NT and Advanced Server, Microsoft offers C2-level security, as does Novell with NetWare 4.0—necessary for work with the United States government—as defined by the National Computer Security Center. Novell also supports this important security addition under its UnixWare product.

NEVER DOWN AND OUT

No casino makes money when the lights go out. Likewise, NOSs must run continuously, with minimal disruption, to keep users on-line and productive.

Hardware manufacturers have taken some of the burden off NOS vendors with fault-tolerant, hot-swapping drive arrays; automatic backups with tape autoloaders; and intelligent uninterruptable power supplies. (See "RAID to the Rescue," September 14, 1993 and "Network Backup Evolves," September 28, 1993.)

Novell heralds its System Fault Tolerance (SFT) levels I, II, and III as the utmost in system reliability. Level I included disk mirroring and level II provides for disk duplexing, but level III delivers full server redundancy (in which duplicate servers remain synchronized). No other NOS vendor provides for a hot server cut-over. If you need nonstop networking, NetWare 3.11 SFT III (and eventually 4.0 SFT III) provide your only solution. In fact, several peripheral benefits have emerged from SFT III for networks, such as the ability to schedule preventive maintenance on servers during normal business hours and to perform upgrades on the fly. Microsoft's Advanced Server has striping compliant with RAID levels 1 and 5.

At the simplest level, a fault-tolerant solution requires a complete system backup to tape for recovery from disasters or system failures. LAN Manager and LAN Server use OS/2 backup tools for this process that must support the High Performance File System (HPFS). VINES requires a backup at the file server to fully support a restore of system-critical files; many consider this a continuing deficiency. Advanced Server, the NetWare product, and VINES all include a basic backup utility.

THE TEMPO

How fast does it go? When you're losing at the tables, very fast! Benchmark testing continues to play a role in providing decision makers with numbers to gauge the performance they might see. In PC Labs' benchmark testing of file transfers, NetWare 4.0 captured top honors for local client transfers, with NetWare 3.11 (with packet burst) placing a strong second, and LAN Server third. Note, however, that many factors affect the performance on your individual network.

Not surprisingly, the 32-bit packages were stronger performers, because they could address more than 16MB of RAM, thus increasing disk cache. NOSs that offered internal packet routing fared poorly when performing that function. Using external routers would improve their performance considerably. Only consider internal routing for providing multiserver wide-area connection flexibility while controlling costs.

Certain protocols perform well on LANs but scale poorly when moving to WANs through remote links and dedi-

A **medium to large network,** with perhaps between 100 and 150 users, has probably got a mix of local and remote sites to be connected. The administrator will be looking for all of the above features, plus probably some remote services for clients and some capacity for multiserver management out of the office. Pricing becomes less important as a determining factor than features, functionality, and performance (we reduced it to 30 percent of our weighting here).

A **large enterprise network** can span dozens or even hundreds of sites. Here, naming and directory services become crucial to maintaining the network. Sophisticated network management is typically employed—probably as support for SNMP—along with huge client/server applications situated on high-performance servers. A network of this type is very likely to need Unix support—for workstations or management consoles. With anywhere from 150 to thousands of users, sites installing a large enterprise network can enjoy quantity pricing. And, in addition, bigger businesses tend to have more to spend. Price as a factor is down to 25 percent here, with reliability, wide-area functionality, and management features the big winners.

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cated or switched communications circuits. NetWare's IPX/SPX protocols performed poorly in the past through WAN links, but Novell developments for large frame sizes and packet burst now enable them to work well through WAN links. LAN Manager, LAN Server, and Advanced Server use NetBEUI as the local transport protocol, but NetBEUI is an unrouteable protocol and can only be bridged. Advanced Server solves this by also supporting TCP/IP. VINES and other Unix derivatives also use TCP/IP for efficient WAN links.

If you need the "X standard" today, NetWare 4.0 gets you closer than any other NOS.

CHANGING YOUR LUCK?

Changing your seat at a table in a casino is fairly easy and sometimes seems to change your luck. As a user though, your luck doesn't always hold when you're trying to browse lists of network resources. Directory services are an important part of the decision matrix for companies just looking for an easy way to find resources that reside on their extended networks—or for the many companies that are moving to the international X.500 directory standard (which works with the established X.400 addressing services).

Novell modeled NetWare 4.0's NDS closely after the X.400/X.500 e-mail addressing specifications and directory services. If you need the "X standard" today—which you may if you have international connections or your network is large and spread out—NetWare 4.0 gets you closest at this point. But more vendors are heading toward X.400/X.500.

If directory services only helped find networking resources, they would pay their way. Most savvy networkers though, look to directory services to bridge user names to their e-mail systems. We can imagine the day when a single user identification added to the network automatically appears within the e-mail system. VINES, by the way, makes this dream a reality today.

FORTUITOUS CONNECTIONS

Any sufficiently advanced NOS server will support the client transport protocols required to accept client access as an applications server. This, however, takes a higher-level protocol that maintains a connection-oriented channel to let clients talk to NOS servers. OS/2 Named Pipes and remote procedure calls (RPCs) in the Unix environment serve this function.

All of these packages support standard transport protocols for access to a server from native client OSs for DOS, OS/2, Unix, and Macintosh. How each NOS works with each application server depends on the application's ability to exploit underlying NOS services. As NOS vendors move to support the Open Software Foundation/Distributed Computing Environment (OSF/DCE) protocols for RPCs, reliance on the underlying NOS will become irrelevant.

Glossary of NOS Terms

API (application program interface) Any standardized set of software interrupts, calls, and data formats used to initiate network services.

Bindery A NetWare 2.*x*/3.*x* database that holds data about various network elements.

domain A jurisdiction of servers and clients controlled and managed by a single server.

driver A layer of software, conforming to an API, that interfaces between the LAN software and the hardware on the network interface card.

IP (Internet Protocol) A communications protocol for networks using Microsoft LAN Manager, NetWare, or VINES. IP software tracks the addresses of nodes, routes outgoing messages, and recognizes incoming messages.

IPX (Internet Packet Exchange) NetWare's native LAN communications protocol, used to move data between server and/or workstation programs running on different nodes.

Named Pipes A communications channel used by applications on Microsoft LAN Manager networks.

NCP (NetWare Core Protocol) NetWare's format for requesting and replying to requests for file and print services.

NDIS (Network Driver Interface Specification) An API developed by Microsoft and 3Com and used by LAN Manager and VINES for LAN adapter drivers. NDIS helps different operating systems and adapters to work together and provides a way to use multiple protocol stacks in the same host.

NetBEUI (NetBIOS Extended User Interface) Microsoft's extension to NetBIOS. NetBEUI is used by LAN Manager, Windows for Workgroups, and Windows NT.

NetBIOS (Network Basic Input/Output System) A specification to link a network operating system with specific hardware. Similar on some layers to IP and IPX. Some vendors use their own implementations of NetBIOS.

NLMs (NetWare Loadable Modules) Applications and drivers that run on a NetWare server and can be loaded or unloaded on the fly.

ODI (Open Data-link Interface) An API developed by Novell for LAN adapter drivers. ODI makes it easy to use a NOS with various LAN adapters and lets you use multiple protocol stacks in the same host.

protocol A specification that describes the rules and procedures that products should follow to perform activities on a network. Protocols enable products from different vendors to communicate on the same network.

SMB (Server Message Block) A formatted message used to request and reply to requests for file and print services in network systems.

TCP/IP (Transmission Control Protocol/Internet Protocol) A set of communications protocols originally developed by the Department of Defense. It is available for many different computers, providing excellent interoperability across networks.

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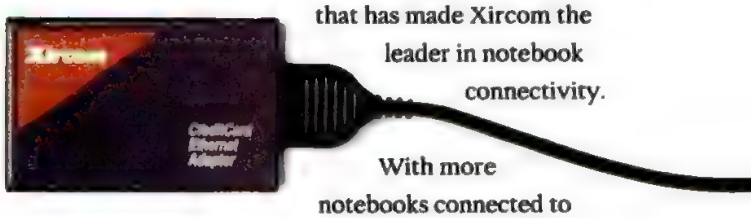

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SCALING UP

Success breeds success. When a casino reaches capacity, it builds an addition to accommodate increased demand. In the same way, NOS buyers want their networking solutions to grow as their demands increase. A simple file and print server today may become an integrated application server in the future.

Again, hardware vendors implement many of the scalable features that a NOS needs in order to grow. Three main subsystems must be scalable to continue growing a server. Disk subsystems must be able to increase in size, server memory must be able to expand to cover applications, and disk cache and more CPUs must be addable to support CPU-bound applications servers.

Within the OSs, support for large logical volumes that span several physical disks becomes a necessity for large client/server databases that include multi-gigabyte files. Server memory should support full CPU capacities, but hardware vendors seldom implement the gigabyte memory sizes available to CPUs.

Today Advanced Server, Unix, and VINES offer symmetric multiprocessing (SMP) options, which allow LAN managers to add CPUs to improve performance. Novell supports asymmetric multiprocessing (AMP), in which applications servers or network adapter cards can off-load the main CPU. For regular file and print services, which remain I/O bound, additional CPUs offer little in performance gains. Only CPU-bound processes will benefit from SMP.

THE AMBIANCE FACTOR

Vendor reputation, stability, market share, third-party support, training, certification, VARs and VADs: A reputation for higher payoffs invariably draws crowds to gaming establishments. NOS vendor reputations and peripheral support influence buyers' decisions.

Novell still holds (depending on whose research you quote) some 55 to 75 percent of the network market. NetWare 3.11 is a stable, scalable NOS architecture—but equally as powerful is its tremendous third-party support.

Microsoft owns the desktop with Windows 3.1 shipping in higher volumes than any competitor. Windows NT extends the Windows metaphor to high-end workstations, and Advanced Server comes out as a competitive NOS.

Banyan's reputation for delivering an excellent wide-area distributed solution in VINES remains untarnished. Performance and scalability remain problems, but the company's emphasis on ENS across multiple platforms may yet endear it to the masses.

IBM's standing as a NOS vendor in the minds of end users continues to be questionable: LAN Server, based on OS/2 2.1, fares quite well in a feature and function comparison, but loses serious points for its ease-of-use problems.

Prospective NOS buyers also need training, support, and reliable service from third-party organizations. Novell's Certified NetWare Engineer (CNE) program has taken on a life of its own, and Novell training programs, books, and tapes abound. Microsoft offers its own Certified Professional Program (but it doesn't currently command the same respect as a CNE certificate).

So where does all of this leave you? NOS solutions span from small workgroups to extended internetworks. The costs to implement these solutions range from thousands to millions of dollars. Careful planning with the goal of implementing a single vendor's solution will pay high rewards in a stable cost-efficient network capable of carrying your enterprise into the future.

LAN administrators, place your bets.

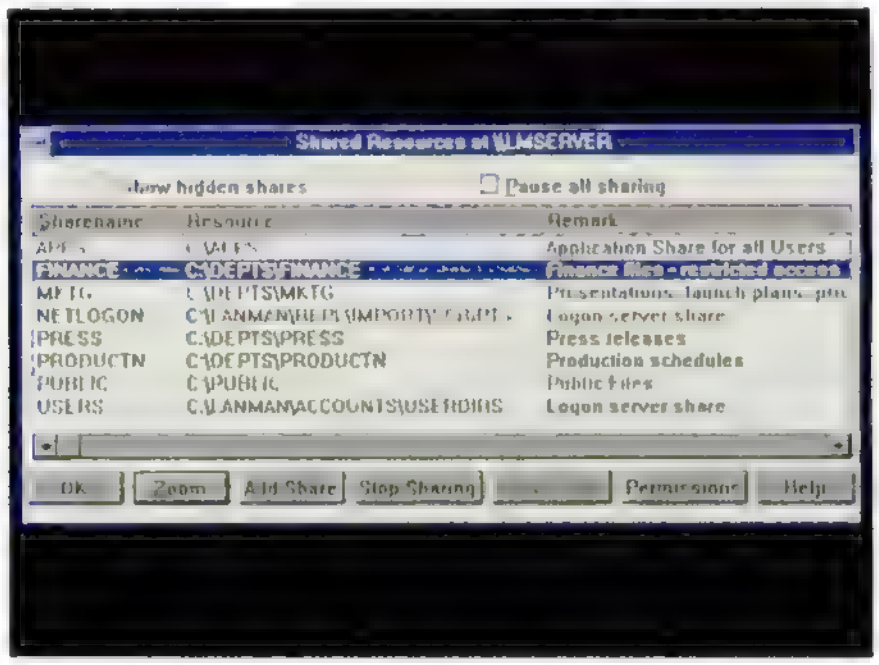
Microsoft Corp.

Microsoft LAN Manager

BY KEN MACKIN

It's really tough to know how to bet on Microsoft LAN Manager, Version 2.2, now that Microsoft is shipping Windows NT and Advanced Server. Microsoft says it intends to keep supporting LAN Manager as long as there is a market demand. It would make sense that having set the ante for its vision of future networking with Windows NT and Advanced Server, changes could come to LAN Manager that would make it as compliant as possible with the two.

In this review, we looked at LAN Manager 2.2 and discovered that not a lot has changed since Version 2.1. Version 2.2 relies on Microsoft's not-yet-gone, wish-we-could-forget-it OS/2 1.3, the latest *Microsoft* version. OS/2 1.3 is a 16-bit operating system (OS), but as some portions of LAN Manager are 32-bit, it requires a 386 or higher. The 32-bit features, such as the HPFS and NetBEUI, run on top of the 16-bit OS/2. In addition, OS/2 1.3 uses a version of Presentation Manager (PM) that is weak compared with IBM's current version. Although it sits on top of OS/2, LAN Manager is not a PM-based architecture; it doesn't use the OS/2 1.3 GUI except for print management.



Microsoft LAN Manager lets administrators control and assign network resources across multiple servers from a single console.

Moreover, as LAN Manager is an application running on an OS/2 platform, you must install and tune *two* operating systems. Sometimes this setup causes trouble. For example, if you log on to the network as ADMIN (administrator), run the NETADMIN utility, and then exit the program, you are returned to a Presentation Manager desktop. Trouble is, you're still logged on as ADMIN and anyone can sit down and rerun NETADMIN without reconfirming the password. This is the kind of situation that can result from having to run two OSs to accomplish one set of tasks.

LAN Manager and its cousins, most notably OS/2 LAN Server, are fundamentally different from the Novell architecture in which the OS and the NOS are

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FACT FILE

Microsoft LAN Manager, Version 2.2

Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-882-8080; fax, 206-883-8101

List price: 5 users, $1,495; 10 users, $2,895; 20 users, $4,595; unlimited users, $8,495; Macintosh client support, $995; remote access server, $995.

Server requirements: 386-based PC or better, 5MB RAM (8MB recommended), 30MB hard disk space.

In short: In spite of its use of a domain architecture, and its support for TCP/IP, SNMP, and multiple protocol stacks on an NIC, Microsoft LAN Manager is tough to recommend in this roundup. Weak administration tools, lackluster performance, and the problems of maintaining two operating systems mark this version of LAN Manager as a NOS that might be past its prime.

501 ON READER SERVICE CARD

one and the same. Microsoft and IBM have said that LAN Manager and LAN Server are not "network operating systems" per se, but that they are applications providing network capabilities to standalone multitasking OSs.

Before you start a whole new game, remember that LAN Manager offers reasonable connectivity for a medium-size LAN, and that numerous enterprise installations of several hundred machines exist. But LAN Manager's administration tools and implementation are weak compared with those of NetWare, VINES, or even LAN Server.

Still, you probably need a few good reasons to run a LAN Manager network. For instance, you've been running one for some time and it's working well, or you're using Microsoft SQL Server or Lotus Notes and want to stick with OS/2 1.3. Otherwise, another NOS would offer better tools and administration.

Although LAN Manager never has sold very well in the United States (compared with NetWare), Microsoft did get a few crucial things right. First, LAN Manager does support TCP/IP (unlike LAN Server) and SNMP, as well as multiple protocol stacks on a network-interface card (NIC) and up to 12 NICs per server, compared with 4 for LAN Server.

LAN Manager includes effective support for disk mirroring and duplexing, as well as uninterruptible power supply (UPS) monitoring, and a version of HPFS—it keeps the fat in RAM for better performance. Microsoft Windows for Workgroups and NetWare connectivity solutions are included in the package, but Mac client support is a separate purchase.

LAN Manager's domain architecture allows a single server or multiple servers to be defined as a single common jurisdiction. LAN Manager also includes support for "backup" domain controllers and "additional" servers, which are usually found acting as database servers.

SUITABILITY TO TASK

Microsoft LAN Manager

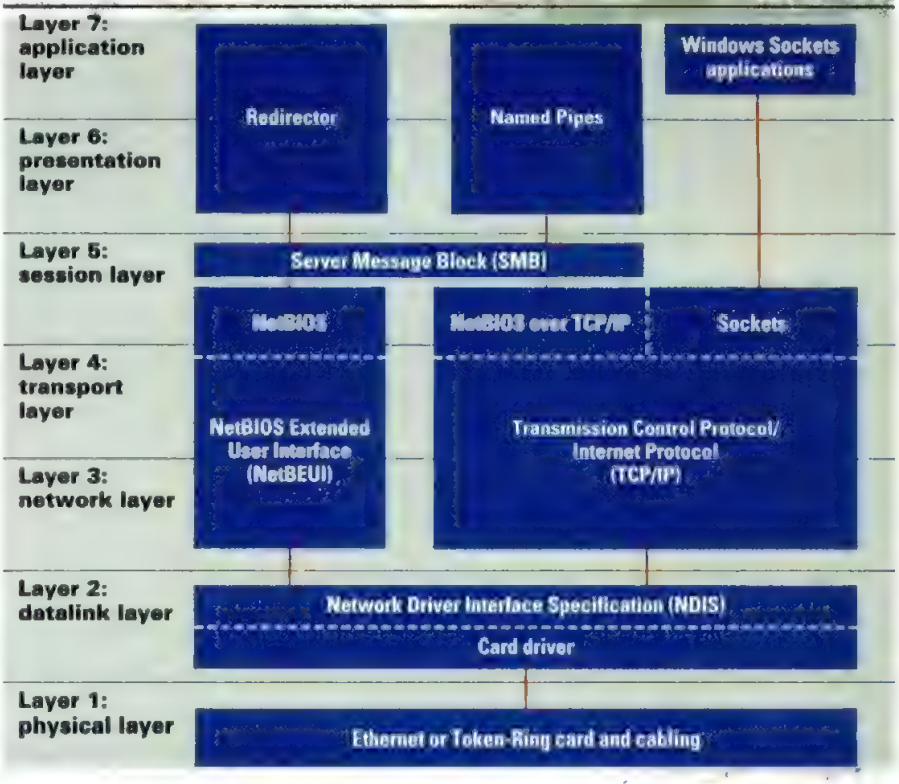
	POOR	FAIR	GOOD	EXCELLENT
Small network	●	●	○	○
Medium network	●	●	○	○
Medium to large network	●	●	○	○
Large enterprise network	●	●	○	○

Microsoft got a few other things right besides the disk caching and file swapping. One very important feature, replicated throughout the LAN Manager universe of products, is the *alias*—a nickname that serves as a shortcut to a network resource.

This is a welcome extension to the cryptic .PRNs, .LPTs, and .COMs of the DOS hieroglyphics. You simply set up your resource, create a name for it, and you've got an alias. Whenever users want to use it, they just refer to it by name. In addition to the communications device and printer aliases, the concept can also apply to a file or directory. The proper substitution of aliases for path and file names can save a lot of typing. This is a capability that should have been added to DOS a long time ago. It is not something that should be limited to networking environments.

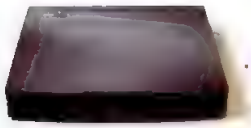
In addition, LAN Manager supports *domains*, a concept that will be familiar to administrators of NetWare 4.0, VINES, and Unix OSs. LAN Manager supports 50 users per domain effectively—that's 50 users per server or set of servers, according to the documentation. (Microsoft says LAN Manager can support as many as 16,000 users per domain, but whether it can do so *effectively* is a question.) In contrast, OS/2 LAN

Microsoft LAN Manager Architecture



It sits, lies down, and does back flips.

Good b



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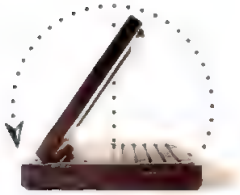
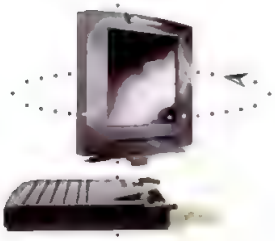
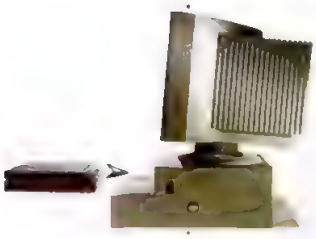


It opens flat up to 180°



Or flips around in just seconds



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The UltraLite® Versa™ notebook gives new meaning to the term "faithful companion."

Versa functions as a pen based tablet to enter notes or data

The reversible screen makes presentations a snap

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Yes, the Versa notebook knows a lot of tricks. Its i486™SL processor is fast and powerful, yet conserves power. Simply swap the floppy drive for an extra battery, doubling battery life.

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NEC

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The UltraLite Versa is the first of a new series of computer products from NEC designed to work together with enhanced functionality and advanced ergonomics.

With the UltraLite Versa you can choose your own best friend.

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Docking Station

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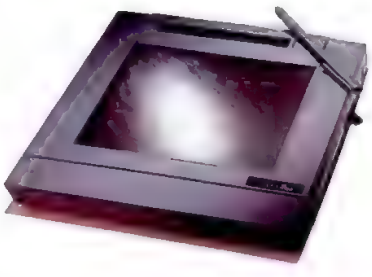
- Integrated microphone and headphone ports

Pointing Device

- Custom Ballpoint™ mouse standard

VersaPad



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Server can support as many as 1,000 users per domain.

LAN Manager was the slowest of all the major NOSs tested in this roundup, turning in numbers comparable with NetWare 2.2's, and like 2.2 it has aged some. This is a five-year-old OS, and it shows in the performance.

It also shows in the tools, which run under DOS and OS/2 1.3 in text mode only. LAN Manager does beat out LAN Server in some respects—such as in the ability to "clone" users and groups while setting up—but these areas are few and far between. LAN Manager gives you most of the tools you actually "need" to network—through command lines, unfortunate though functional OS/2 text screens, and an outdated version of Presentation Manager. The on-line help is not truly context-sensitive and the documentation is dense, although it is more approachable than IBM's documentation for LAN Server.

By itself, LAN Manager provides an outdated but still functional set of tools that deliver lackluster performance, as tested here. It's probably not a good risk as a new purchase with some of the other NOS solutions now available, unless you have a special need for it.

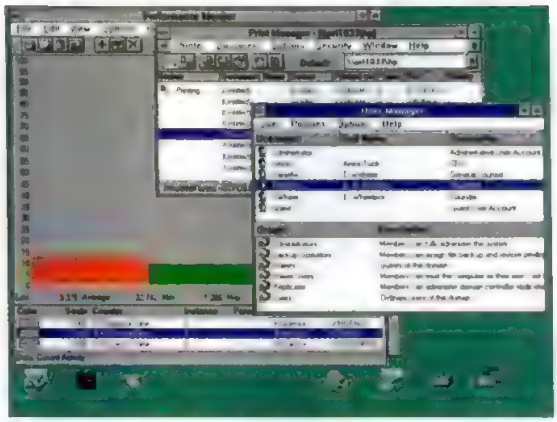
Microsoft Corp.

Microsoft Windows NT with Advanced Server

BY KEN MACKIN

After tipping its hand for months, Microsoft has finally laid its cards on the table introducing Windows NT with Advanced Server. It's an interesting hand, as you might expect—a few great cards, a few you might change if you could, but certainly playable.

Microsoft has actually played two networking hands: Microsoft Windows NT is rather peer-to-peer, and Microsoft Windows NT with Advanced Server is a client/server solution. The peer Windows NT could be called "Windows NT for Workgroups—with security": It includes 32-bit recompiles of the Windows for Workgroups goodies, Microsoft Schedule+ and Microsoft Mail. Advanced Server is a hefty rewrite of much of LAN Manager. Here we reviewed Microsoft Windows NT along with Microsoft Windows NT with Advanced Server.



Windows NT's familiar interface lets administrators configure users and user groups with little more than a few mouse clicks.

Advanced Server supports remote network installation; symmetric multiprocessing (Advanced Server supports four processors, NT two); RISC, including the MIPS R4000, and (possibly by the time this is in print) Digital's Alpha boxes; a scheme for centralized management; abandonment of .INI, CONFIG.SYS, and AUTOEXEC.BAT files; sophisticated user-profile management; network-based printing; built-in backup for LAN Manager 2.*x* and NT workstations, Windows for Workgroups computers, and Advanced Server systems.

Microsoft says that Advanced Server is not an NOS, but it does have direct access to the NT kernel and acts as part of the kernel. This could be responsible for a slower than expected performance. We observed no significant performance differences, no matter which of the three available memory models was chosen. In our testing, Advanced Server fared only slightly better than LAN Manager. But speed is only one issue among many.

What are the benefits for administrators and users in the new NOS? Some good ones are centralized control and management of users and local or global groups, by way of a consistent, familiar-looking, and mostly friendly interface, and excellent support for Macintosh environments.

Microsoft does come out of the gate with C2 security, but other aspects of its security had a few quirks. It was broken up into user, group, file, volume, and MACFile security. There is no security object here, only security as an element of other objects, and the controls for it are spread throughout Advanced Server's tools. One major and nearly undocumented factor in the Advanced Server security scheme is this: If you give a user Full Control of a directory, or volume, he or she has complete control, even if a file in that controlled directory is set off-limits. Only a true administrator should be able to override individual file security.

The installation is easier than NetWare's and LAN Server's. The program supports many card types automatically—Microsoft has done an exceptional job with its detection products, sensing Intel, 3Com, and Novell cards effortlessly. Using the CD-ROM and a floppy disk, the installation stops only to ask you a few important questions.

Windows NT Servers are grouped in domains that are "managed" by a domain controller, which keeps everything synchronized in the group—exactly as LAN Manager and LAN Server work. Backup domain controllers exist just in case the main one dies.

The domain structure of LAN Manager, replicated in Advanced Server and

FACT FILE

Microsoft Windows NT with Advanced Server

Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-882-8080; fax, 206-883-8101

List price: $2995; Workgroup connection, $33 per client for DOS and Windows 3.*x* workstations.

Server requirements: 386DX/25-based PC or better, (also runs on RISC-based systems), 16MB RAM, 100MB hard disk space.

In short: This OS supports symmetrical multiprocessing, global directory services, and centralized management of users and groups; it offers excellent Mac support. Its performance lagged, and Microsoft was addressing significant problems with drivers. This product will eventually be a viable choice, with an easy installation and sophisticated storage technology

502 ON READER SERVICE CARD

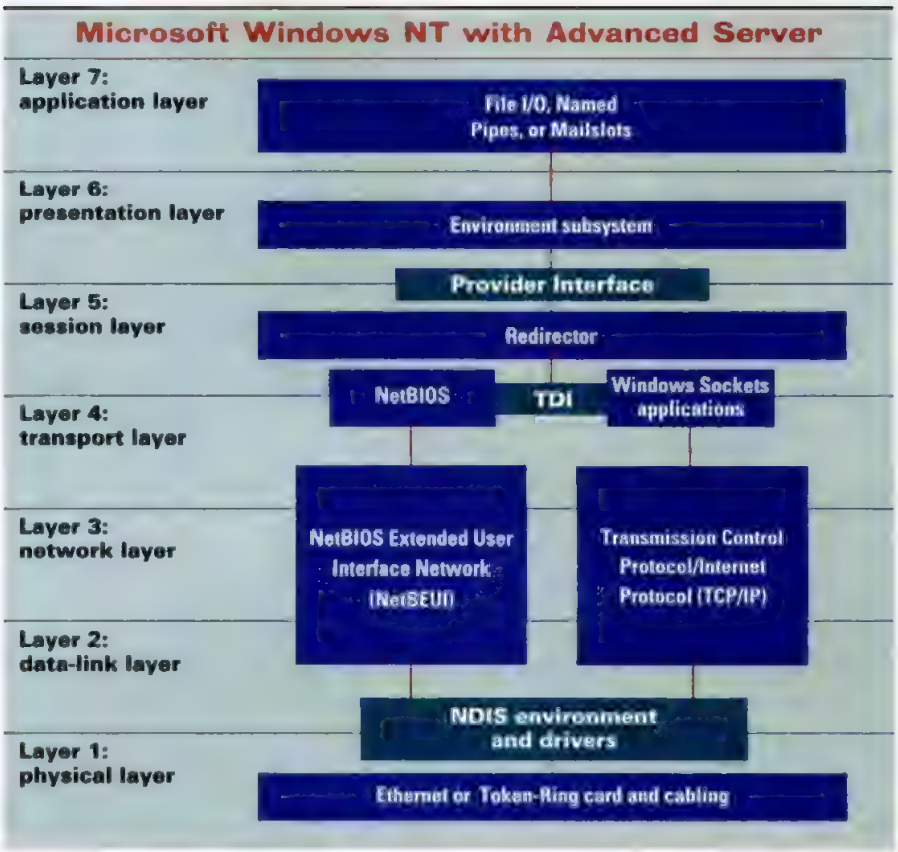
LAN Server, is a problem for companies that are moving to enterprise-wide connectivity. Though domains can establish *trusted relationships* with other domains under Advanced Server, the structure of the network cannot reflect or respond to the changing organization well.

The addition of trusted relationships certainly makes it easier to manage complex environments, but a trusted relationship with another domain is a modest response to a big problem. It means that you can avoid replicating users on different servers. But once you set up your overall domains, any changes you make—renaming a domain or adding servers—mean rebuilding your network.

But none of these products addresses this issue. Only VINES comes close with flat-file StreetTalk databases, which allow you to make a change and see it reflected across the network. But VINES stores security on the local machine where your account was created, making that the only server that can authenticate. At least Advanced Server will copy authentication data to the backup domain controllers, enabling log-ons even if the main domain controller is down.

Global and local groups are also part of Advanced Server. A global group can contain any user local to the domain with access to resources on other domains. The local group can contain any trusted user or global group with access to a local resource. Keep in mind that local and global refer to resource availability, not users.

Advanced Server disk I/O has several important features. One is a disk-management scheme that allows users to disk mirror, disk duplex, and data stripe. With many vendors now selling "software-only" RAID solutions, Microsoft's support of so-called RAID 0, RAID 1, and RAID 5 is not surprising, but data striping and RAID support above level 1 are emerging storage techniques. You buy four disks instead of two, and still have fault tolerance only one level deep. LAN Server, the NetWare products, and LAN Manager allow for RAID 1 and duplexing, but stop short at striping and RAID 5.



Protocol support here is quite similar to that in previous offerings from Microsoft and IBM. NDIS is supported with TCP/IP and NetBEUI, as well as IPX/SPX. Notable here is AppleTalk support, and data-link control (DLC) for talking to network-based printers.

SUITABILITY TO TASK

Microsoft Windows NT with Advanced Server

	POOR	FAIR	GOOD	EXCELLENT
Small network	●	●	●	○
Medium network	●	●	●	○
Medium to large network	●	●	●	○
Large enterprise network	●	●	●	○

Some of the protocol support, IPX/SPX in particular (NWLink), appeared unstable in PC Labs testing. In follow-up testing, the problem was found to be more related to adapter drivers and the binding of multiple protocols with multiple NICs. This is the kind of last-minute bug that probably will be fixed by the time you read this, but it caused considerable concern in a shipping product at the time.

The Macintosh support is noteworthy. Advanced Server supports Mac volumes for Mac users on an AppleTalk network, and PostScript printing for the AppleTalk clients. It even printed the AppleTalk PostScript jobs on an HP LaserJet III that had no PostScript on-board.

If you are a dedicated Microsoft networking customer and need better networking, Advanced Server is for you. Or you may want to add a new server and PostScript RIP to your AppleTalk network; it was a solid performer on the small AppleTalk network we used. If you are a Microsoft SQL Server user and want something better than OS/2 1.3 to run it on, give Advanced Server a shot. If you don't have big performance needs, it could work for you. The Microsoft player, Advanced Server, doesn't win all the chips, but it certainly can pay its own way in the NOS game.

Novell Inc.

NetWare, Version 2.2

BY GARRY FRENKEL

Like the ubiquitous quarter and dollar slot machines in a casino, the installed base of the NetWare 286 line still makes up the broadest portion of Novell's share of the network market. But Novell says

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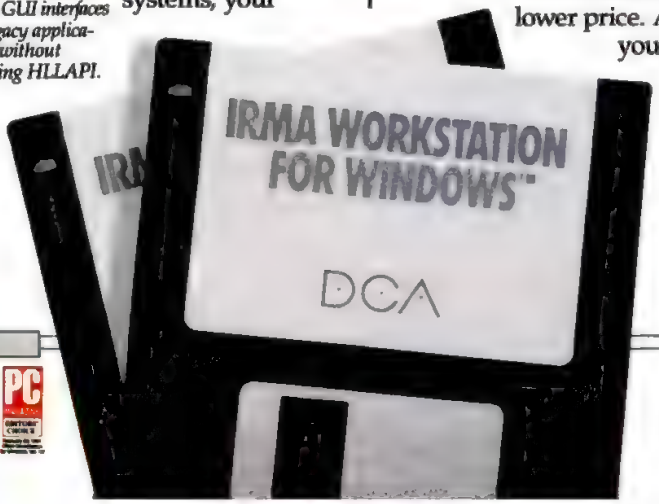

yes It runs with NetWare

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intel inside

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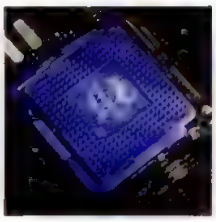

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CIRCLE 359 ON READER SERVICE CARD

this predominance is changing, and NetWare 2.2, the pinnacle product in the line, is showing its age, architecturally and otherwise. It's a tribute to Version 2.2's design that its richness of features and dependability still keep it in the game with the newer 32-bit big-payoff boys. It might still be a solid bet in limited circles if it weren't for Novell's aggressive pricing of NetWare 3.11.

NetWare 2.2's feature fitness in today's market falls short when you start to list the networking issues that face today's corporations—management and support of multiple protocols, wide area connections, and flexibility and ease of use in managing the NOS under constantly changing network scenarios. It could not keep up in our benchmark testing when it came to tasks reflective of larger networking. This is understandable when you remember that NetWare 2.2 was developed during the era of the 286 and that the 16-bit 2.2 will still run on an AT-class machine. Understandable, yes, but not acceptable as an enterprise solution.

The toughest hurdle for NetWare 2.2 today, though, must be the pricing and positioning of NetWare 3.11. A few years back, Novell responded to its smaller workgroup customers and addressed confusion in its 286 line by merging the various versions of NetWare 286 into one. NetWare 2.2 allowed a company that was just getting into LANs to start with an $895 5-user version and grow from there.

NetWare 386 was initially released with only a single 250-user version, and even by the time NetWare 2.2 came out, the "entry-level" NetWare 3.*x* version was a 20-user license at $3,495. Today things are vastly different. A 5-user version of NetWare 3.11 now lists at $1,095 compared with NetWare 2.2 at $895. Even the 100-user level shows only a thousand-dollar difference between the $5,995 NetWare 2.2 and the $6,995 NetWare 3.11. Is it worth $10 less per user for a company to invest in NetWare 2.2?

We noted the mix of old and new that is contained in an operating system caught between and across chip generations. Although NetWare 2.2's installation and configuration are much improved over those of its predecessors, our

Banyan's ENS Fills a Global Gap

by David Linthicum

Novell's release of NetWare 4.0 earlier this year brought a variety of features not included with earlier versions, the most significant of which was the NetWare Directory Service (NDS). NDS is a global distributed object database that tracks and maintains users, servers, printers, and other network components. But its emulation of the Bindery notwithstanding, NDS's lack of support for older NetWare 2.*x* and 3.*x* networks leaves many NDS wannabees—who lack the budget for NetWare 4.0—out in the cold.

Banyan Systems fills the void with Enterprise Network Services (ENS), an NDS-like product based on Banyan's popular StreetTalk Directory Service for VINES. Included in the $3,995 price are StreetTalk Directory Assistance (STDA), the Banyan Security Service, Banyan Network Management, and, of course, support for IPX/SPX. Server modules are sold separately, and other options are available.

Administrators using ENS can add users, alter security parameters, manage electronic mail services, and dynamically move files and devices across existing NetWare 2.*x* and 3.*x* file servers that are connected to local or wide area networks. As with NDS, as changes occur using ENS, they are automatically distributed across the servers, centralizing and simplifying server management.

ENS builds the global directory *automatically* from existing NetWare Binderies, converting the entries to StreetTalk names. Establishing ENS at the server requires either an NLM for NetWare 3.*x* or a VAP (value-added process) with a license key for NetWare 2.*x*.

CHASING NETWARE 4.0

In addition to support for older NetWare networks, the newest release of ENS, Version 2.0, supports NetWare 4.0. This could prompt some administrators to abandon plans to upgrade to NetWare 4.0 as they find it easier (and cheaper) to maintain "older" versions of NetWare.

One of the more interesting features of ENS 2.0 is the *dual redirector,* which enables NetWare servers and VINES servers to share files, thus eliminating a major drawback for organizations with a mixture of Banyan and NetWare servers. Also included is a gateway option that enables NetWare users to connect to mainframes using 3270 emulation, and new support for Macintosh clients.

WHEN, WHERE, AND WHY

Generally, if you're sold on the functionality of NetWare 4.0, and upgrading all of your servers is just a matter of time, then NDS is the way to go. It replaces the NetWare 2.*x* and 3.*x* Binderies, it's an effective directory service, and it is closely tied to the CCITT X.500 standard.

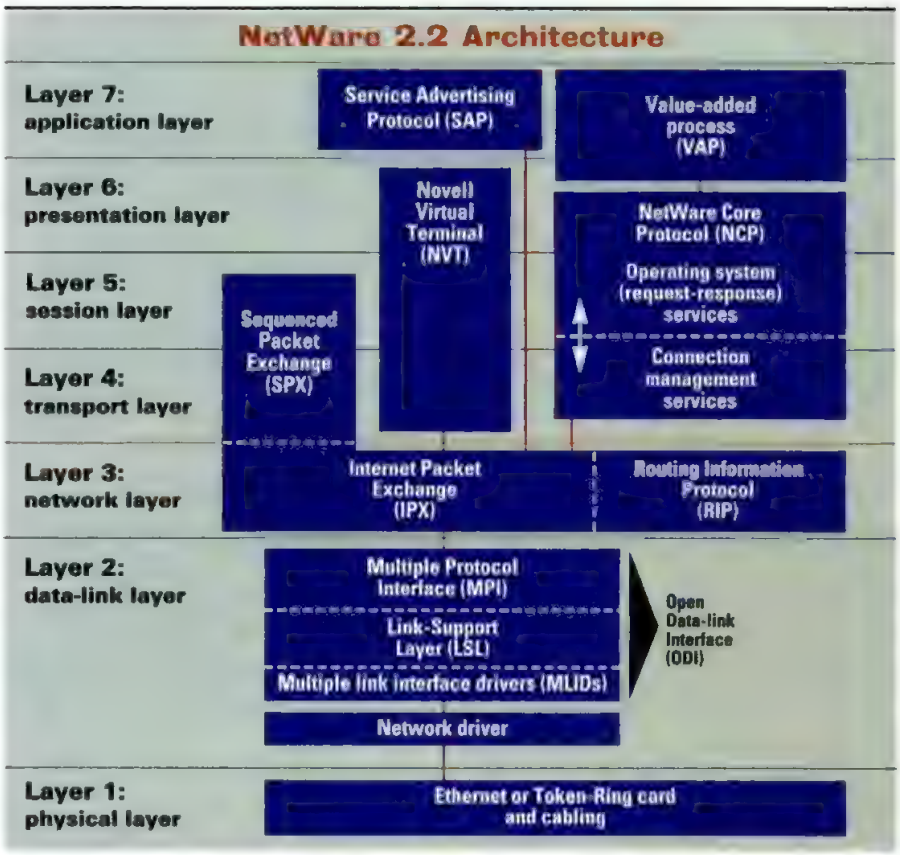
If your organization has the normal hodgepodge of servers and operating systems, then ENS is for you. ENS is based on a global management of diverse and distributed servers. For many companies, ENS is invaluable. Banyan's future plans for ENS are interesting as well. In 1994, it plans to release a new version of ENS that will support Windows NT.

ENS has given new life to older NetWare servers and networks. ENS enables NetWare users to purchase just what they need, when they need it—without having to commit to Version 4.0 to obtain a single desired feature: a global directory. □

installation still required over an hour, plus a fair amount of disk shuffling. And, most painful, if you want to add your server to a WAN and need to change a network address or server name, or add a new network interface card, you must relink and recompile the operating system. With NetWare 3.11 or 4.0 this is accomplished with a few keystrokes.

NetWare 2.2's documentation is extremely well-written and organized and is replete with helpful screen shots. During installation, on-line help is available for each screen as is the case with the rest of the NetWare utilities.

NetWare 2.2 is the ninth generation of the NetWare 286 line, a maturity evident in the administrative utilities for user and file management. Setting up users, establishing account permissions, and managing the directory structure are all handled by a series of well-designed menu-driven and command-line utilities. It was not until NetWare 4.0, however, that Novell offered a global directory service as an inherent part of NetWare. Help for NetWare 2.2 comes from Banyan, in the form of Enterprise Network Services for NetWare (ENS), which essentially delivers a portion of Banyan's StreetTalk global naming service to NetWare networks (see the accompanying sidebar "Banyan's ENS Fills a Global Gap"). NetWare 2.2 also lacks the remote console feature that can be found in NetWare 3.11 and 4.0.



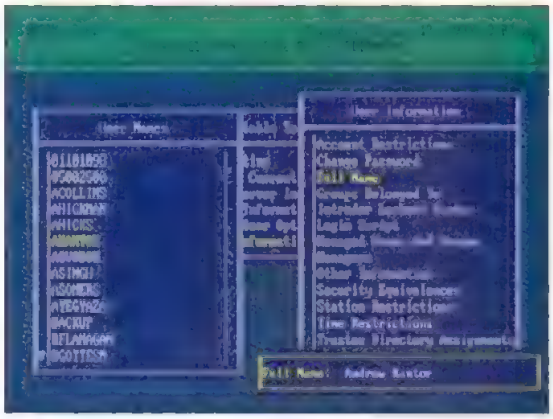
Architecturally, NetWare 2.2 is familiar, but dated. It does not have the multithreaded processing capabilities of NetWare 3.11 and 4.0, even though it can run server-based applications called value-added processes (VAPs). But VAPs are considered difficult to write and few are available. NetWare 3.11, on the other hand, has a myriad of server-based applications called NetWare Loadable Modules (NLMs) available, ranging from network-management applications to SQL servers.

Interestingly, the most notable VAP for NetWare 2.2 is the Macintosh VAP, which allows a NetWare 2.2 server to double as an AppleShare server and emulate a networked Apple LaserWriter printer. These Macintosh VAPs come standard with NetWare 2.2, whereas the Macintosh NLMs are a separate purchase for the newer versions of NetWare. Thus, a small Mac-heavy office might find NetWare 2.2 a good deal.

NetWare 2.2's server support for protocols other than IPX is limited to AppleTalk Filing Protocol (AFP).

On the client side, NetWare 2.2 uses the same drivers as do NetWare 3.11 and 4.0. The client shells support NetBIOS and Named Pipes, and by using Novell's ODI drivers, a NetWare 2.2 workstation can concurrently support TCP/IP.

NetWare 2.2 offers competitive fault tolerance, security, and print services. Where it cannot compete is in advanced



NetWare 2.2's C-Worthy interface allows LAN managers to choose user and other options from an expanding series of pop-up menus.

FACT FILE

NetWare, Version 2.2

Novell Inc., 122 E. 1700 South, Provo, UT 84606; 800-453-1267, 801-429-7000; fax, 801-429-5775

List Price: 5 users, $895; 10 users, $1,995; 50 users, $3,995; 100 users, $5,995

Server requirements: 286-based PC or better, 500K RAM (2.5MB recommended).

In short: This 16-bit NOS can still run on a 286, but it cannot offer multithreaded processing capabilities, nor does it support wide-area connectivity or multiple protocols. Installation takes a lot of time and some disk shuffling. It might still be a good choice in limited circles but for the aggressive pricing of NetWare 3.11 Possibly the most interesting built-in capability of NetWare 2.2 is a server-based application that lets its server also act as a Macintosh AppleShare server.

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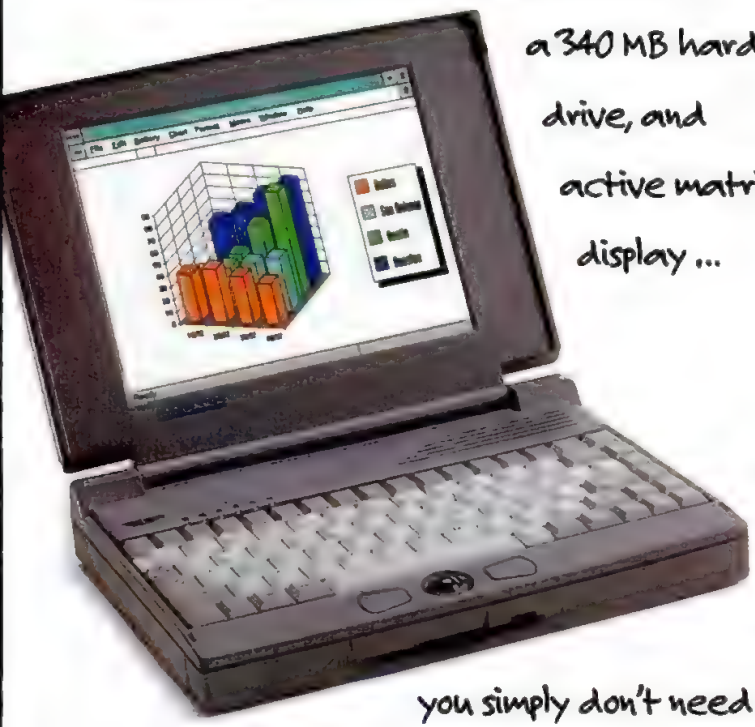

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SUITABILITY TO TASK

NetWare, Version 2.2

	POOR	FAIR	GOOD	EXCELLENT
Small network	●	●	○	○
Medium network	●	●	○	○
Medium to large network	●	●	○	○
Large enterprise network	●	○	○	○

features, such as server memory and server storage. Its maximum server memory is 12MB, while NetWare 3.11 supports up to 4GB. NetWare 2.2's maximum volume size is 255MB, and volumes cannot be split across multiple disks.

With the NetWare 2.*x* family still the most widely installed version of NetWare, Novell should do its users a favor and offer an upgrade trade-in program that is too good to be passed up. As it is, NetWare 2.2 offers firepower sufficient for a single-server network. But if you want better performance, or if you might *ever* need to support multiple protocols or multiple networks, then place your bets somewhere else.

Novell Inc.

NetWare, Version 3.11

BY PADRAIC BOYLE

For a solid bet—a proven product—NetWare 3.11 continues to be a strong, flexible leader in the NOS arena for small to large networked sites. Its only real shortcoming for those who need a complete enterprise solution is that it does not have a global directory service. But this can be addressed in part with Novell's NetWare Naming Service (NNS) or with Banyan's ENS, which delivers a portion of StreetTalk distributed services to NetWare LANs.

Boasting file and printer sharing, speed, security, support for most OSs, and for a vast amount of hardware, NetWare 3.11 truly is a powerful product. (Who leaves the table or machine when they're winning?) Although it has some difficulty with memory management, it's still a great payoff.

When Novell first introduced the 32-bit NOS, one of the principal attractions was its modular design. NLMs could be upgraded without having to rebuild the

Unix on a Server or as Your NOS?

by David S. Linthicum

It may seem an interesting alternative to your usual game: Unix as your OS, with support for DOS networking. Unix brings some interesting capabilities to the table, but is it the NOS of choice for an organization that supports only DOS and Microsoft Windows? Certainly not. Performance and cost are the two biggest reasons. Consider it only if you have a mix of DOS and Unix clients.

Okay, how about a Unix-based file server sitting on your NetWare or LAN Manager network? That's a fine consideration, again, when both DOS and Unix-based workstations are in the mix. You can create this Unix file-server solution on Intel or non-Intel processors using Unix with the proper networking software.

What Unix offers is an advanced operating system that can run on multiple hardware platforms, such as RISC, SPARC, and Intel (Microsoft Windows NT with Advanced Server now delivers this also).

Of the many advantages Unix salespeople may cite to make a case for using Unix as a DOS file server, only a few are reasonable.

First, support of advanced chips means that some fairly fast hardware can be used for DOS file servers. Second, the built-in networking features of Unix allow its DOS clients to access other services not provided when conventional DOS NOSs are used. Finally, organizations with a mix of DOS and Unix clients may find servers that support the sharing of both DOS and Unix files more effective than the integration of separate DOS and Unix file servers.

The major disadvantage to the Unix file-server solution is cost. The DOS client software for Unix/DOS networks (such as those based on NFS) can cost $200 to $400 per DOS or Windows computer. At $200 per user, a 50-workstation network can cost an organization $10,000. And that's just for the DOS/Windows client software.

Performance is another problem. Unix is fast, but not when it is used for DOS file service. Unix was written as a general-purpose, multitasking OS. The Unix networking software that provides the DOS file sharing is just one of many tasks and network protocol stacks running on the server. It isn't possible to get the type of DOS file and printer service performance that is expected from conventional DOS file servers such as NetWare. NOSs such as NetWare were specifically designed to optimize file services and so contain related advanced features, such as support for delayed writing to disk (used to optimize file writes).

WHEN YOU SHOULD CONSIDER UNIX...

Convenience in connectivity—not performance or economy—must be your goal if you're considering Unix. If file sharing is required in an organization that supports both DOS and Unix, a Unix file server may be the solution.

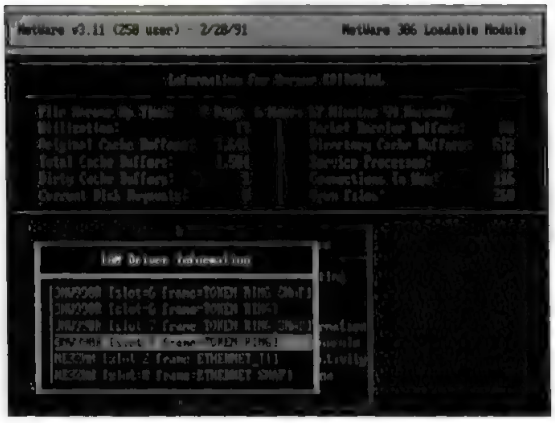
...AND WHEN YOU SHOULDN'T

Some DOS- and Windows-only organizations have been sold on the idea of a Unix-based computer as the file server of choice. The fact that Unix can run on advanced processors can be misleading. Many have believed that Unix on an advanced processor must be faster than a NOS running on the slower PC. Nothing could be further from the truth. A Unix-based file-server almost never makes good sense for DOS- and Windows-only clients. Network performance goes down and the cost goes up—not a good bet. □

entire NOS, and they could be loaded on the fly. Moreover, only the modules needed would be plugged in to the NOS, reserving memory for better uses such as disk caching. One drawback with this design is in memory usage. NLMs are loaded into ring 0 and can crash the server if the NLM is not written properly or clashes with another vendor's NLM. In addition, some modules do not release the memory hooks when they are unloaded. (These problems have been addressed in NetWare 4.*x*.)

As a diagnostic procedure to identify problem NLMs, you can load each into ring 3 temporarily to see how it behaves (you'll take a performance hit, but it's worth it). If the NLM fails, it will only take itself down, not the entire server. You can move NLMs over to ring 0 when you're confident in their operation. When an NLM is unloaded, all memory is returned to the pool for distribution where it is needed.

NetWare 3.11 allows support for multiple protocols and OSs on one server. SPX/IPX and TCP/IP are both supported out of the box; support for NetWare File Services, Macintosh, and OSI can be added at additional cost. Novell can load multiple protocol stacks on one network adapter using its proprietary driver specification, ODI, which is similar to Microsoft's NDIS. Most NIC manufacturers supply both. Support for DOS and OS/2 is shipped with NetWare 3.11; Macintosh and Unix NFS name spaces are available separately.



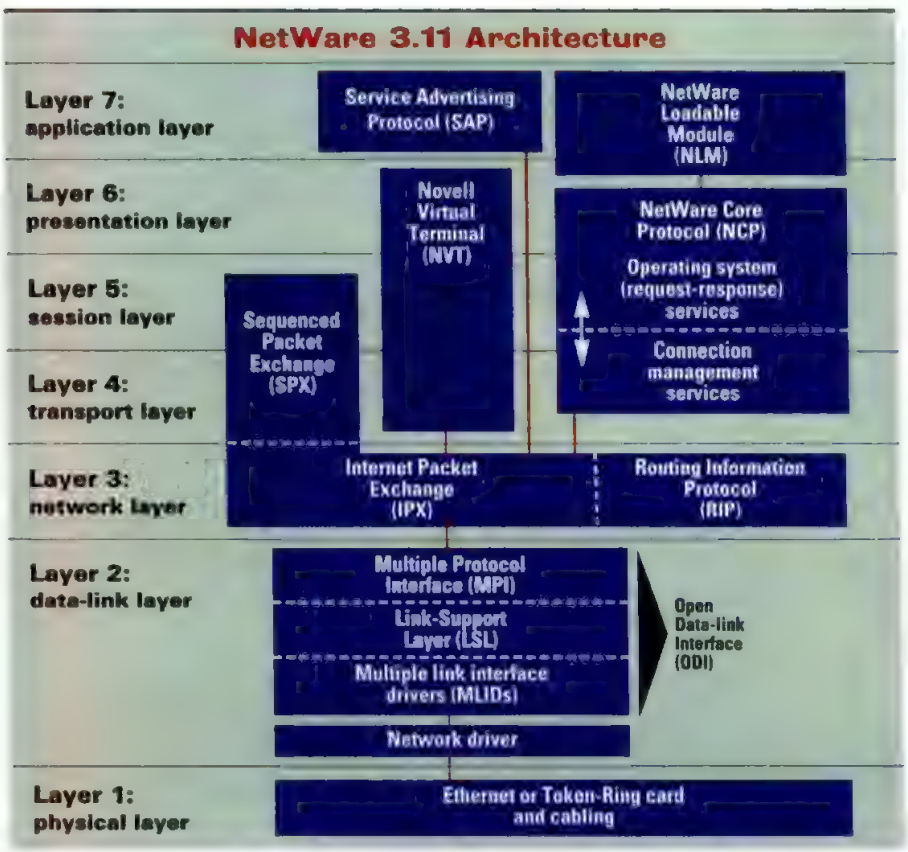
Sticking with a winner, Novell provides NetWare 3.11 with the same C-Worthy interface as Version 2.2.

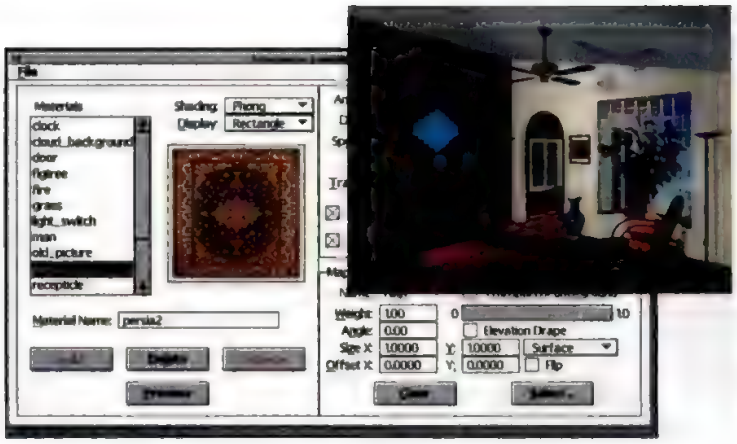
NetWare 3.11 is designed mostly for small to moderately large networks consisting of individual servers, principally because its directory services do not integrate the network as a whole. Each server maintains an individual authentication database called the Bindery. The server's Bindery holds the information for that particular server and information such as log-on names, passwords, access rights, and print information. If users need to connect to more than one server to share resources, they must be added manually to each server.

A separate add-in, Novell's NNS for $1,995, does ease the administration problem. By letting the administrator place servers in *domains*, NNS allows any update to a server to be propagated automatically to each of the other servers in its domain. The other solution is Banyan's ENS (for $3,995), which essentially delivers some of the VINES StreetTalk distributed services to NetWare 3.11. (Novell addressed the call for an enterprise directory capability in NetWare 4.0 with the NetWare Directory Services.)

Although installation is easy to follow, it is not menu driven, and it does require some knowledge of NetWare and of loading NLMs. The SERVER.EXE file starts the server and prompts for the server name and internal IPX number. Once this information is provided, the server is technically up, but no users can attach or log-on yet. After the disk driver NLM is loaded, another NLM, Install, offers a menu that takes you through the creation of the partition and volumes configuration. Once this process is completed, the network adapter must be loaded and configured. Finally, AUTOEXEC.NCF, which is boot file information, and STARTUP.NCF are created. A first-time installation may seem difficult, but it does get easier.

The client installation is only partially menu driven, with the assistance of a program called WSGEN.EXE. Clients may also be configured using ODI drivers and the NET.CFG file, a route that requires more experience, but is more flexible. Novell's security is offered in three levels: password encryption over the wire, valid log-on name and password, and access rights. Unlike NetWare 2.*x*, once a user





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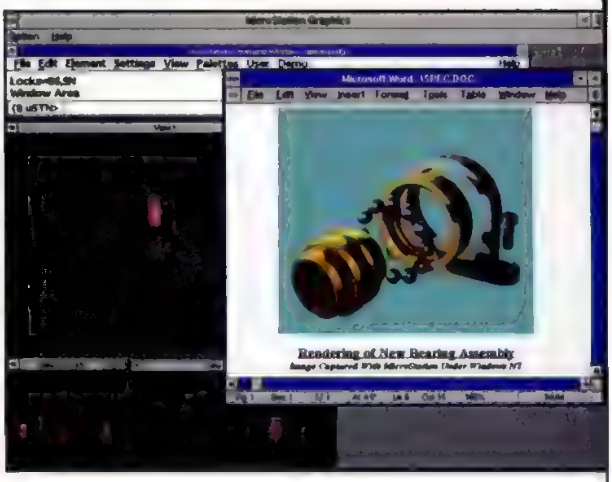

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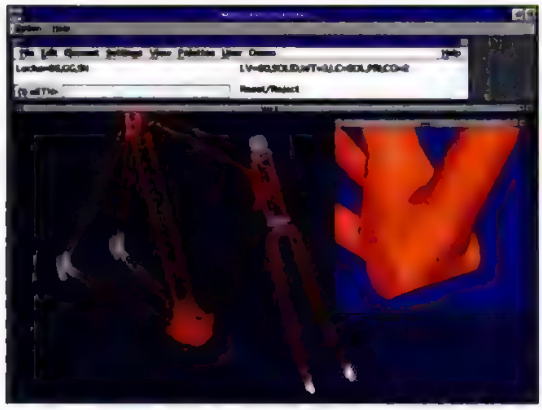

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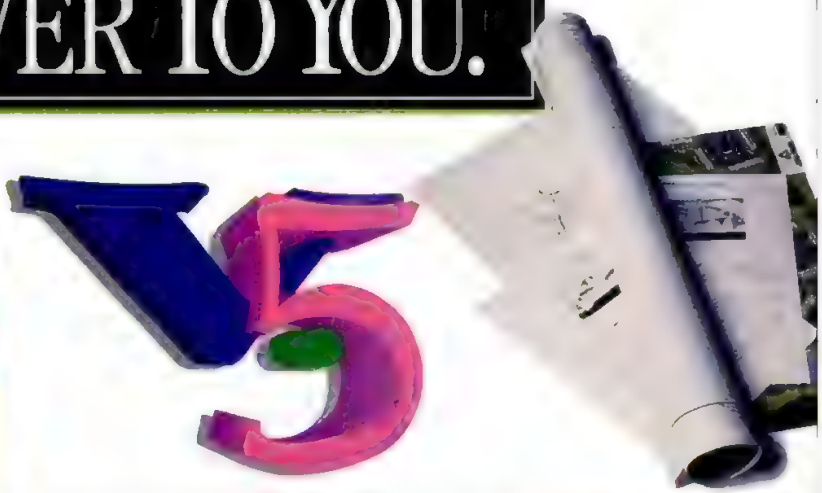

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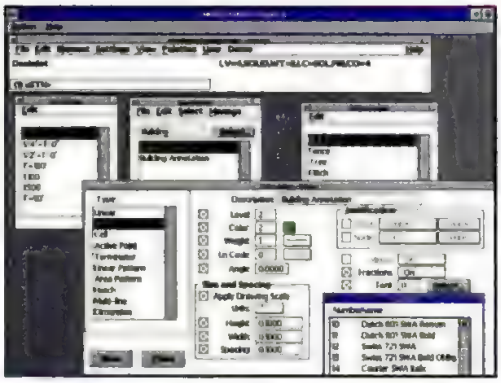

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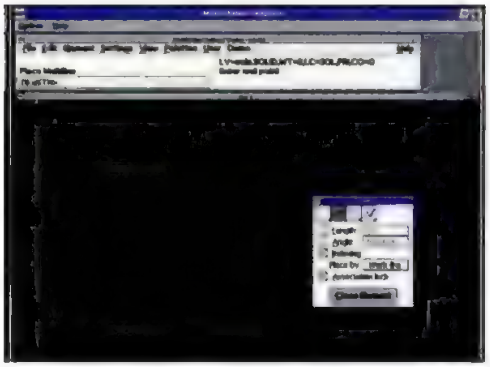

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attempts to log-on to a server, the passwords are encrypted at the workstation and unencrypted at the server. This prevents the possibility of a packet analyzer capturing and viewing a password as it is sent over the wire. If users from a 2.*x* server attempt to log-on to a 3.11 server they will be denied access (unless they are users of that 3.11 server). Rights can be granted at the volume, directory, or file level. Thus, if for some reason a user only needs the right to access one file on a server, it can be done.

SUITABILITY TO TASK

NetWare, Version 3.11

	POOR	FAIR	GOOD	EXCELLENT
Small network	●	●	●	●
Medium network	●	●	●	●
Medium to large network	●	●	●	●
Large enterprise network	●	●	●	○

NetWare 3.11 is still one of the fastest performers in this group. Edging out VINES and LAN Manager, and running neck and neck with NetWare 4.0, NetWare 3.11 performed admirably in each of our benchmark tests. We observed a remarkable performance difference between the standard NETX shell and the BNETX shell with PBURST.NLM loaded on the server, although additional memory overhead was incurred on both the workstation and the server. Novell's built-in routing capability, although helpful in saving the cost of a standalone router, did not perform well in our tests. If a station had to route through one server to reach another server over a backbone configuration, the packet would be cut into 512-byte packets from 1,518 bytes (Ethernet packet size). Novell is investigating this, looking for a solution.

Performance, scalability, flexibility, speed, and support make NetWare 3.11 a top pick for small to moderately large companies. However, if yours is a large corporate enterprise network, you'll also want to look into NetWare 4.0 or VINES, which fill in some of the gaps still present in NetWare 3.11.

PC MAGAZINE EDITORS' CHOICE

FACT FILE

NetWare, Version 3.11
Novell Inc., 122 E. 1700 South, Provo, UT 84606; 800-453-1267, 801-429-7900; fax, 801-429-5775

List price: 5 users, $1,095; 100 users, $6,995; 250 users, $12,495

Server requirements: 386-based PC or better, 4MB RAM, 50MB hard disk space.

In short: Boasting security, excellent hardware support, good file and printer sharing, speed, scalability, and top-notch technical assistance, NetWare 3.11 is a force for newer NOSs to reckon with. Despite some problems with memory management, it remains an excellent choice, its shortcomings in the distributed directory services can be addressed with Novell's add-in NNS or Banyan's ENS. Consider NetWare 3.11 for all but the most extensive enterprise or global networks

504 ON READER SERVICE CARD

Novell Inc.

NetWare, Version 4.0

BY PADRAIC BOYLE

With the challenges of global networking continually upping the stakes for the high-end rollers in the NOS game, Novell plays a strong hand with NetWare 4.0, which offers simplified multiserver log-on, resource sharing, and centralized management in a feature-rich, coherent package. In addition, NetWare 4.0's benchmark test scores were good for an NOS so loaded with functionality. But the ante is high: Anticipate a learning curve with NetWare 4.0 for some of its important new elements, be prepared to do a lot of network planning up front, and check your budget.

NetWare 4.0 is not for everyone. Whether you really need such a powerful NOS depends upon the size, configuration, and complexity of your LAN and—with a price tag of $1,395 (5 users) to $47,995 (1000 users)—your budget. NetWare 4.0 builds on the capabilities of NetWare 3.11, adding many new features. Some of the more attractive ones are the NetWare Directory Services (NDS), file compression, block suballocation, file migration, and Windows-based management.

NDS is at the nucleus of NetWare 4.0. Based on the X.500 "standard," NDS is a hierarchically designed database that replaces the Bindery in previous NetWare versions. All of the network's information is stored in the NDS. NDS views all network entities as objects, each of which is a pointer to a user, a group of users, print servers, or a server volume. With this move Novell does not leave behind Bindery users; NDS can emulate a Bindery, making it easier for sites that will upgrade one server at a time and have a mixed environment of 2.*x*, 3.*x*, and 4.*x* servers.

The real beauty of NDS is the fault tolerance it delivers. If the server that contains your information is down, NDS searches its database on the other servers to piece together your information and allow you to log-on to the network. This is possible because the NDS database is replicated across all servers in the network in *partitions*, which maintain all of the network's information. In contrast, Banyan's StreetTalk keeps a user's information on only one server: If that server goes down, so do you.

One of your first challenges with NetWare 4.0, though, is planning your directory tree structure, a most important part of providing a functional network. Instead of multiple single servers that make up a network, there are multiple servers that are the network. Because each network is different there is no set way to configure one, but once set, you cannot change the structure dynamically.

NetWare 4.0's management module runs under Microsoft Windows, giving a new face to NetWare network system administration.

Block suballocation, file compression, and file migration are some of the attrac-

▶ SUMMARY OF FEATURES CONTINUES

Network Operating Systems

PC MAGAZINE

Products listed in alphabetical order

■ = YES □ = NO

	Microsoft LAN Manager, Version 2.2	Microsoft Windows NT with Advanced Server	NetWare, Version 2.2	NetWare, Version 3.11	NetWare, Version 4.0	OS/2 LAN Server, Version 3.0	VINES, Version 5.25(5)
Maximum file size	2GB	1,700GB	255MB	4GB	4GB	2GB	Unlimited
Maximum number of file locks	8,192	Limited by RAM	2,000	100,000	100,000	Limited by RAM	26
Maximum number of file opens	8,192	Limited by RAM	1,000	100,000	100,000	64K	250
Total hard disk storage	7.8GB	Limited by RAM	2GB	32TB	32TB	48GB	206GB
Support for DOS files at server	■	■	■	■	■	■	■
Support for Macintosh files at server	Optional	■	■	Optional	Optional	Optional	■
Support for NFS files at server	□	□	□	■	■	Optional	□
Support for OS/2 files at server	■	■	■	■	■	■	■
Support for Unix files at server	□	■	□	■	■	■ (third-party)	■ (third-party)
Volumes/files can span multiple hard disks	□	■	□	■	■	□	□
Architecture							
CPU architecture supported	386, 486, Pentium	x86, Alpha, MIPS	286	386, 486, Pentium	386, 486, Pentium	386, 486, Pentium	386, 486, Pentium
Dedicated/nondedicated server	■■	□■	■□	■□	■□	■□	■□
Maximum number of server connections per user	DOS clients, 26; OS/2 clients, unlimited	Limited by RAM	8	8	Limited by RAM	100	Limited by RAM
Maximum number of user connections per server	Limited by RAM	Limited by RAM	100	250	1,000	1,000	Limited by RAM
Multiple-processor support	□	■	□	□	□	□	■
Multitasking and multithreading	■	■	□	■	■	■	■
Multiuser operating system	■	■	■	■	■	■	■
Memory Usage							
Dynamic memory resource allocation	■	■	□	■	■	■	■
System is protected from application access in recommended configuration	■	■	□	□	■	■	■
Maximum cache size	8MB	2GB	12MB	4GB	4GB	Less than 4.2GB	Limited by RAM
Maximum amount of RAM	16MB	4GB	12MB	4GB	4GB	4.2GB	256MB
Minimum memory requirement	8MB	16MB	2.5 MB	4MB	6MB	8MB	8MB
Network Security							
C2 certification	□	Pending	□	□	■	□	Pending
Access to operations by user name and user group	■	■	■	■	■	■	■
ACLs (access control lists) managed on per-file basis	□	■	□	□	□	■	■ (with file service directory)
ACLs (access control lists) stored with files	■	□	□	□	□	■	■ (with file service directory)
User can limit amount of hard disk space	■	□	■	■	■	■	□
Manager can require periodic password changes	■	■	■	■	■	■	■
Offers intruder detection/lockout	■□	■□	■■	■■	■■	■■	■■
RSA public and private key cryptography	□	□	□	□	■	□	□
Network Printing							
Maximum number of shared printers per server	7	Limited by RAM	5	16	255	24	20
Assigns priorities to print queue	■	■	■	■	■	■	■
Multiple printers on one queue	■	■	■	■	■	■	■
Multiple queues on multiple printers	■	■	■	■	■	■	■
Multiple queues to a single printer	■	■	■	■	■	■	■

SUMMARY OF FEATURES

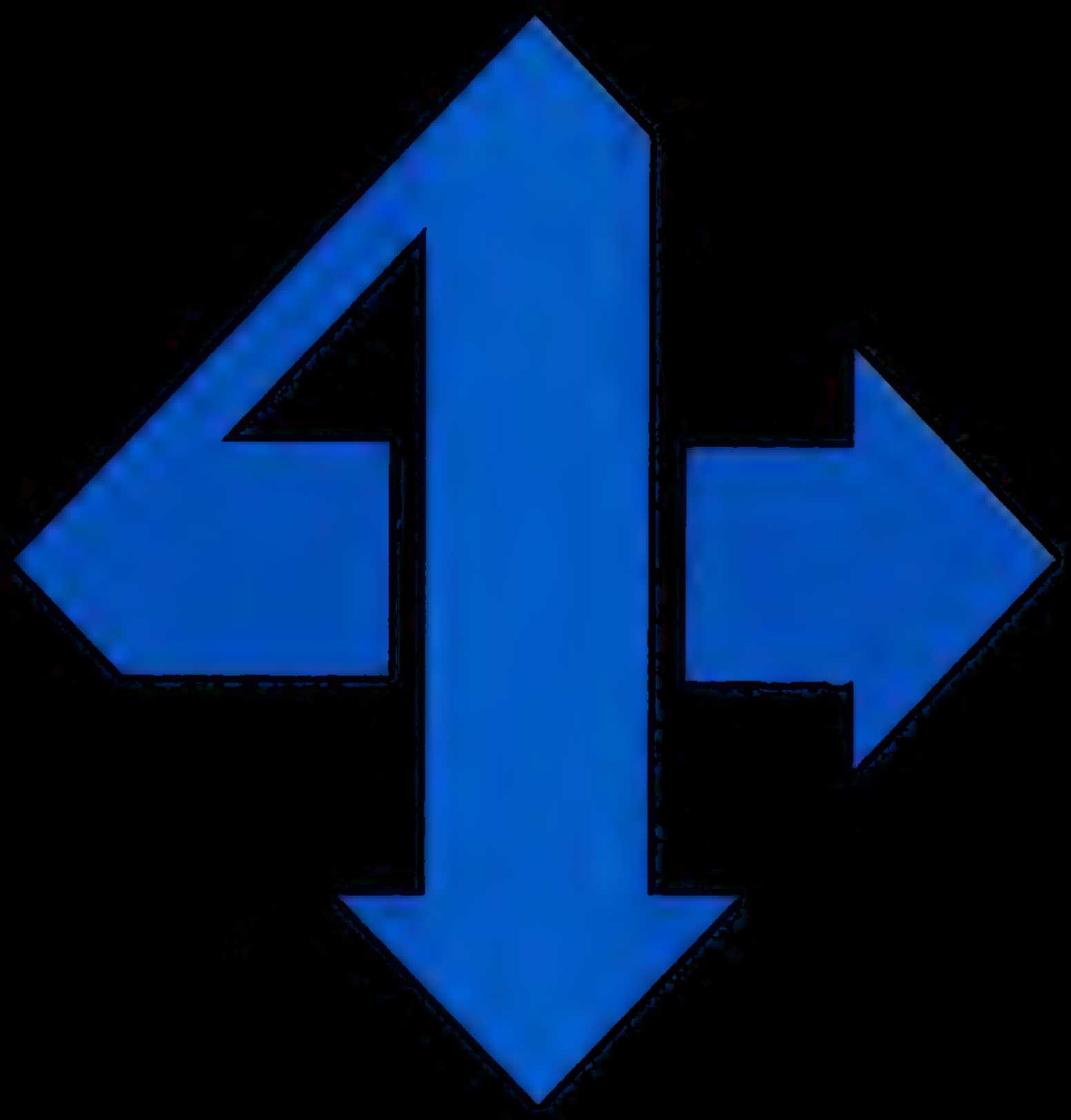
CONTINUES

Products listed in alphabetical order

■ = YES □ = NO

	Microsoft LAN Manager, Version 2.2	Microsoft Windows NT with Advanced Server	NetWare, Version 2.2	NetWare, Version 3.11 (PC MAGAZINE)	NetWare, Version 4.0	OS/2 LAN Server, Version 3.0	VINES, Version 5.25(5)
Network Printing (continued)							
Operator notification of printer problem	■	■	■	■	■	■	■
Automatically downloads print drivers to workstations	□	■	□	□	□	■	■
Remote queue management	■	■	■	■	■	■	■
Works with remote workstation printers	□	■	■	■	■	■	■
Notifies user of job completion	■	■	□	■	■	■	■
Protocol Support							
AFP (AppleTalk Filing Protocol)	Optional	■	■	■	■	Optional	■
FTP	Optional	■	□	■	■	■	■
IPX/SPX	■	■	■	■	■	■	■
Large Internet Packet	□	□	□	Optional	■	□	□
NetBIOS (Native)	■	■	■	■	■	■	■
OSI	■ (third-party)	□	□	■	■	□	□
TCP/IP	■	■	■	■	■	Optional	■
Local Server Management							
Displays error and system status log	■	■	■	■	■	■	□
Displays the number of packets and bytes sent and received	■	■	■	■	■	■	■
Displays cache statistics	■	■	■	■	■	■	■
Displays cache utilization	■	■	■	■	■	■	■
Displays hard disk information	■	■	■	■	■	■	■
Displays LAN-driver statistics	■	■	■	■	■	■	■
Displays logical-disk statistics	■	■	■	■	■	□	■
Displays the number of open files	■	■	■	■	■	■	■
Displays paging statistics	■	■	■	■	■	■	■
Displays the percentage of CPU utilization	■	■	■	■	■	■	■
Displays physical disk statistics	■	■	■	■	■	■	■
Displays redirector statistics	■	■	■	■	■	■	■
Displays server data statistics	■	■	■	■	■	■	■
Displays session statistics	■	■	■	■	■	■	■
Can display statistics of third-party server services	■	■	□	□	□	■	■
Can assign single-reference time server	□	■	□	□	■	■	■
Remote Server Management							
Asynchronous remote-console administration	■	□	□	■	■	■ (third-party)	■
Local-like operation	■	■	□	■	■	■	■
Remote-console modem callback	■	■	□	■	■	■ (third-party)	□
Remote-console session security	■	■	□	□	■	■ (third-party)	■
Remote installation	■	□	□	■	■	■	□
Remote upgrade	■	□	□	■	■	■ (third-party)	■ (maintenance release only)
Supervisor Administrative Functions							
Directory services	■	■	□	□	■	■	■
Directory services security	□	■	N/A	N/A	■	□	■
File system	■	■	■	■	■	■	■
Can move objects in directory services tree	□	■	N/A	N/A	■	□	■
Printing	■	■	■	■	■	■	■

N/A—Not applicable The product does not have this feature



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Backlit VGA, Built-In Pointer, PCMCIA

Users asked for VGA. The new HandBook's screen is a black-and-white VGA display, backlit for use in any lighting situation. No need to carry a mouse with your HandBook 486. The built-in pointing device is convenient and easy-to-use. The HandBook 486 also includes one PCMCIA Type II slot, and the card fits entirely within the footprint of the HandBook.

The Bottom Line

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HandBook 486 models start at only $1,495, an extraordinary value even by Gateway's standards — and we wrote the book on value! We have a reputation for offering the best prices on high-quality products with exceptional service from friendly folks in the Midwest. Give us a call. Once you get your hands on a HandBook, you'll wonder how you ever lived without one!

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3. Slice the folded edge
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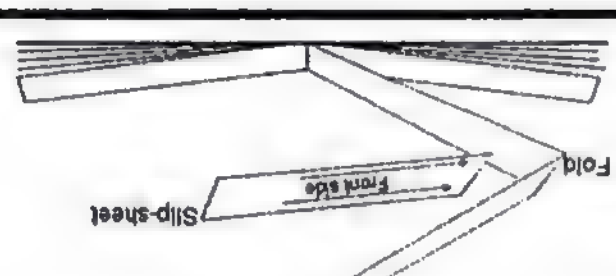

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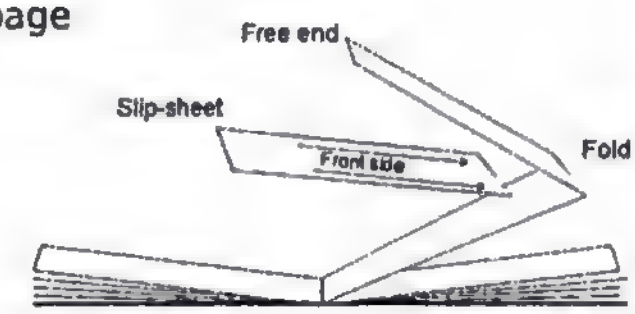
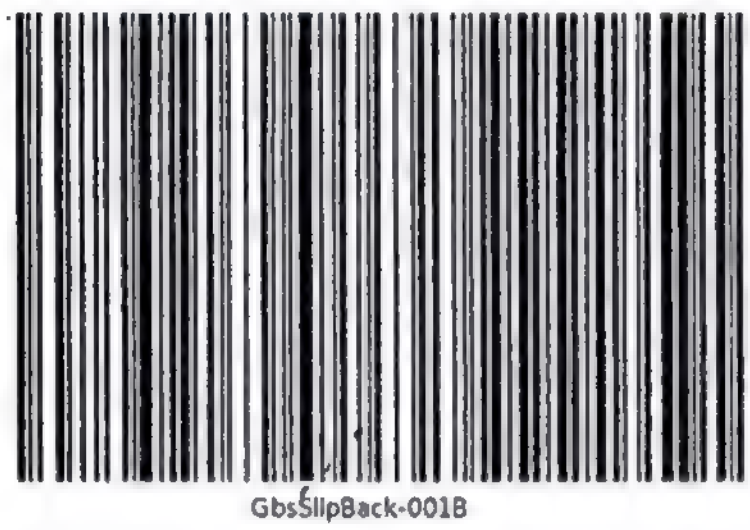
3. Slice the folded edge
4. Close the page and slip-sheet





Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

Your Hawg, Your Dog, And

"You'll have to pry my cold, dead fingers off to get it away from me." That's what an editor told us once about the Gateway 2000™ HandBook we sent him for evaluation.

A journalist covering the conflict in Somalia called to tell us his HandBook was so popular among his colleagues that he could sell dozens of them for us.

Another user wrote, "The HandBook has changed my life in a way that only a few other products ever have. I take it everywhere with me — something I never did with other notebooks."

This is a tiny sampling of the response to the original HandBook. Clearly, the HandBook — the pioneer product in an entirely new category dubbed "subnotebook" computers — inspired the kind of loyalty usually reserved for Harley-Davidson® motorcycles and man's best friend.

Introducing The HandBook 486

Now we are proud to introduce the next generation of the HandBook — the HandBook 486. Since we began marketing the original HandBook a little over a year ago, we've been asking customers to finish this statement: "I'd like my HandBook better if _____." The HandBook 486 includes most everything anybody asked for while retaining all the things people love.

The HandBook 486 still weighs under three pounds and is smaller than the day planners many people carry. The new HandBook still has a great keyboard, excellent battery life, a backlit screen, and that wonderful HandBook suspend/resume feature. But the new HandBook has some important features the original didn't have.

Introducing The HandBook® 486!

The HandBook 486 has a handy, integrated pointing device.

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FEATURES

Size

The difference between a 3-pound portable and a 4-pound portable doesn't sound like very much until you lug one around for hours. Then every ounce counts! HandBook users swear by the size of this product. It's big enough to be fully functional, but small enough to take anywhere effortlessly.

SL Enhanced Intel 486® Processor

Your HandBook 486 includes a genuine 32-bit, 3.3v SL Enhanced Intel 486 processor — not some chip that's *almost* a 486. Those who crunch numbers will love the high-performance numeric coprocessor in the DX2.

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The HandBook's VGA display is easy on your eyes. The screen is backlit for use in all lighting situations so you won't ever be left in the dark.

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A PCMCIA slot is a great way to add a modem, network card or any of dozens of available PCMCIA-compatible peripherals.

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- Weight: 2.9 Lbs.
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- 25MHz SL Enhanced Intel 486SX Processor
- 4MB RAM (expandable to 20MB)
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- Integrated Pointing Device
- 78-Key Keyboard
- Parallel, Serial & PS/2 Ports
- MS-DOS® 6, Windows™ 3.1, Interlink and Serial Download Cable

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- 130MB IDE Hard Drive
- 7.9" Backlit VGA Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
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SUMMARY OF FEATURES

ENDS

Products listed in alphabetical order

■ = YES □ = NO

	Microsoft LAN Manager, Version 2.2	Microsoft Windows NT with Advanced Server	NetWare, Version 2.2	NetWare, Version 3.11 (PC MAGAZINE)	NetWare, Version 4.0	OS/2 LAN Server, Version 3.0	VINES, Version 5.25(5)
Supervisor Administrative Functions (continued)							
Copy inhibit (.COM or .EXE)	■	■	□	■	■	■	■
Create	■	■	■	■	■	■	■
Delete	■	■	■	■	■	■	■
File scan	■	■	■	■	■	□	■
Grant	■	■	■	■	■	■	■
Hide directories and files	■	■	■	■	■	■	■
Indexed (set by OS)	□	□	■	■	■	□	□
Modify	■	■	■	■	■	■	■
Read only	■	■	■	■	■	■	■
Rename inhibit	□	■	□	■	■	■	■
Sharable attributes	■	■	■	■	■	■	■
Supervisor right	■	■	■	■	■	■	■
View	■	■	■	■	■	■	■
Audit Trails							
File and object access	■	■	□	■	■	■	■
Log-on and log-off	■	■	■	■	■	■	■
System restart and shutdown	■	■	□	□	■	■	■
System errors	■	■	■	■	■	■	■
User and group management	□	■	□	■	■	■	□
Network Directory Services							
Global name service	□	■	□	■ (NNS add-on)	■	■	■
Globally distributed database	□	□	□	■ (NNS add-on)	■	■	■
Host Connectivity							
327*x* remote gateway option	■	Optional	■	■	■	Optional	■
Asynchronous gateway option	■	■	■	■	■	Optional	■
Asynchronous terminal emulation software option	■ (third-party)	■	■	■	■	Optional	■
Remote Access Service							
Included in package	□	■	□	□	□	□	□
Secure callback options	■	■	■	■	■	■	□
Supports asynchronous telephone communications	■	■	■	■	■	■	■
Supports dial-in using client/server architecture	■	■	■	■	■	■	■
Supports ISDN	□	■	■	■	■	■	■
Supports PAD	□	□	■	■	■	□	■
Supports X.25	■	■	■	■	■	■	■
Mac Support							
Included in the package	□	■	■	□	■	□	□
File and print server	■	■	■	■	■	■	■
Gateway to other AFP servers	■	■	□	■	■	□	■
Integrated security	■	■	■	■	■	■	■
Integrated tools	■	■	□	■	■	■	■
Supports RIPing	□	■	■	■	■	□	■
Drivers Supported							
NDIS	Client, server	Client, server	None	None	Client	Client, server	Client
ODI	None	Client	Client, server	Client, server	Client, server	OS/2 client	None

FACT FILE

NetWare, Version 4.0
Novell Inc., 122 E. 1700 South, Provo, UT 84606; 800-453-1267, 801-429-7900; fax, 801-429-5775

List price: 5 users, $1,395; 10 users, $3,195; 100 users, $8,795; 250 users, $15,695; 1,000 users, $47,995
Server requirements: 386-based PC or better, 6MB RAM, 12MB–60MB hard disk space.
In short: Novell seems focused on again setting a standard for NOSs in NetWare 4.0. It builds on all the best of NetWare 3.11 and adds superb fault tolerance, a global directory service, file migration and compression, and a Windows-based central management module. The restructured directory and other new capabilities mean a significant learning curve, and the price for all this power will tend to make it most attractive to managers of large, multiserver, distributed networks.
505 ON READER SERVICE CARD

tive features in Version 4.0. Block suballocation intervenes in a situation where, for example, a file that is, say, 2K large is stored on a server that has 4K blocks. Normally, the 2K of disk space is wasted, but with block suballocation turned on, that space would be used by other files to fill the rest of the block. Using a ratio of about 2:1, file compression also can make a big difference in your hard-disk storage space. File migration is a feature that has been offered in some tape backup packages. Novell has incorporated it, along with High Capacity Storage Systems (HCSS), in NetWare 4.0. HCSS allows you to set flags on files by date and move them off to other media. A phantom stub is left on the volumes so that if a user attempts to access the file, it is copied back over transparently.

With NetWare 4.0, Novell also adds Windows-based management software bringing in the old and new configuration features used in SYSCON, PCONSOLE, and PRINTDEF. The GUI attributes make it easy to add, move, delete, and modify network objects.

The server installation process under this new version is complete and simple, and is delivered under a totally menu-driven install procedure. A CD-ROM that contains all the install files means no disk swapping: After you install the first server, you copy all contents of the CD-ROM up to the server's volume so that additional servers are installed much more quickly over the network.

Novell has also overhauled the workstation shell, replacing two files, IPX and NETX, with modules. The Virtual Loadable Modules (VLMs), which offer a more flexible solution for the workstation, are loaded into memory by the VLM Manager. The VLM Manager automatically takes advantage of available upper memory, conserving conventional memory. VLMs take up less conventional memory than their predecessors did, and with packet burst built-in, even less memory than BNETX (the net shell for burst-mode use on a workstation).

As they are modules, VLMs can be added or removed from a workstation simply. In addition to the new shells, better Windows support adds a graphical interface to ease the problems of attaching, logging out, mapping a drive, and connecting to a print queue.

SUITABILITY TO TASK
NetWare, Version 4.0

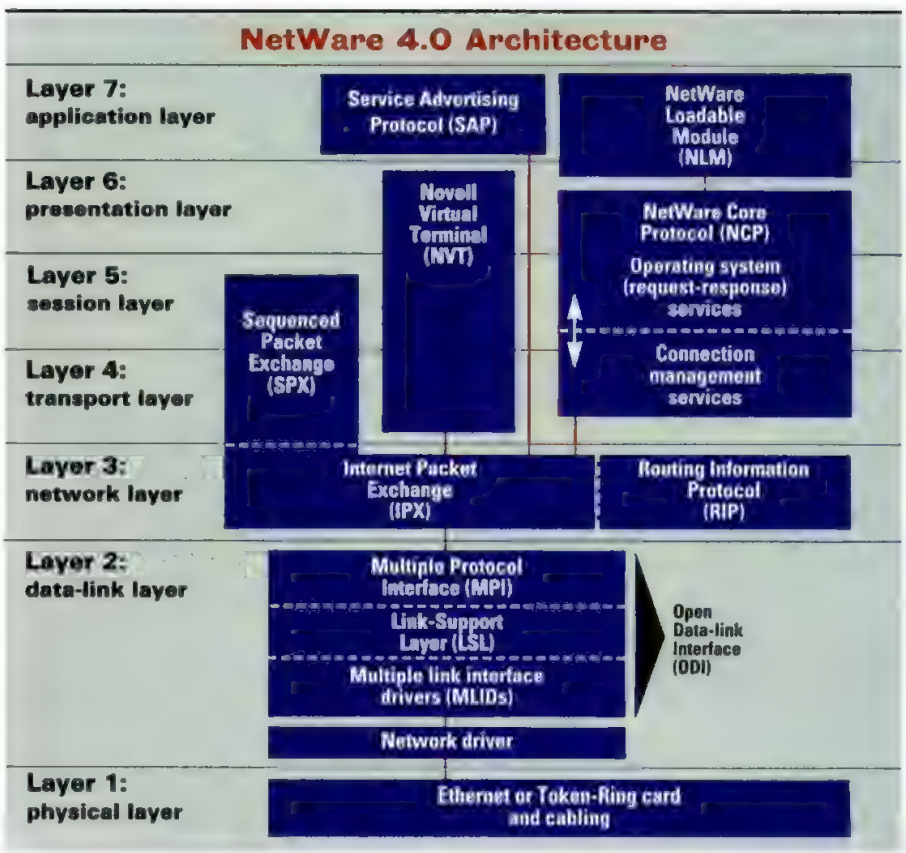
	POOR	FAIR	GOOD	EXCELLENT
Small network	●	●	●	○
Medium network	●	●	●	●
Medium to large network	●	●	●	●
Large enterprise network	●	●	●	●

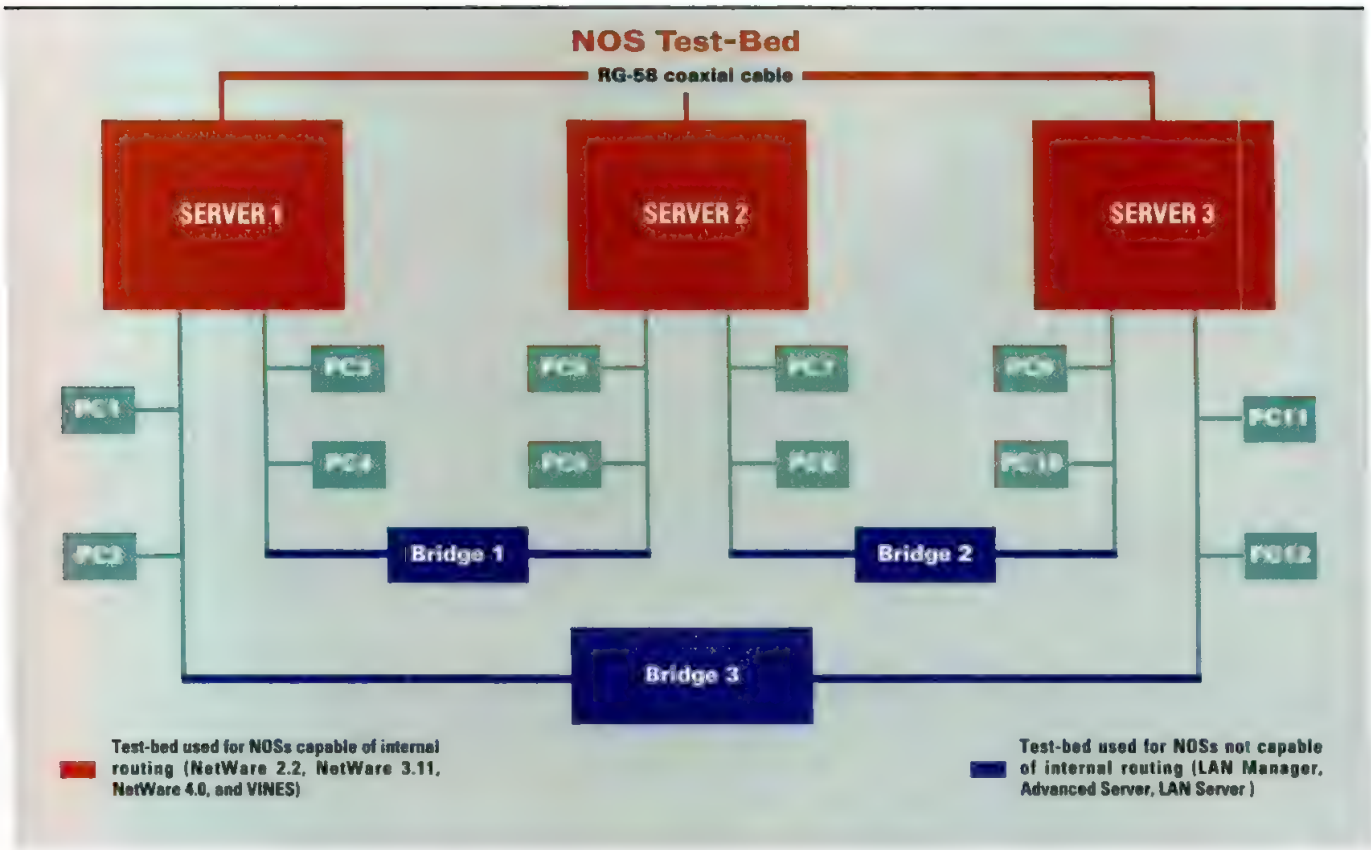
UPGRADE ANTE

Three transfer routes are available for upgrading from NetWare 3.11: across-the-wire to a 4.0 server, across-the-wire on the same server, and in-place. Across-the-wire to a 4.0 server is the safest procedure, but could be the most expensive. A separate server must be brought up with NetWare 4.0 and put on the network. If you have a spare server lying around, you could leapfrog from server to server, upgrading each as you go.

Going across-the-wire on the same server involves some risk to data integrity. A client with either a large enough hard disk or tape backup system is needed to store the server's data temporarily while the server is being reconfigured for NetWare 4.0.

An in-place upgrade also involves some risk, mostly from a possible failure during the upgrade. Just make sure you have a complete backup of your network server before you begin this process. And





note—this procedure is not available to NetWare 3.0 servers; you must first upgrade to NetWare 3.1 or higher.

NetWare 4.0's performance was the best here, but fairly close to that of 3.11. Even so, that's a good payoff considering the additional features of 4.0. Note also that although Novell offers internal routing, saving you the ante of purchasing separate routers, some speed is lost. Even with NetWare 4.0's Large Internet Packets (LIP) and built-in burst mode, we were still receiving packets that were being cut down from 1,518 bytes to 512. (Novell is looking into a solution.)

Novell was thinking globally in other ways with 4.0 as well: They put all of the manuals on-line. It's a definite plus. Under Windows, the manuals are shown as icons, and you search on topics or commands. (Incidentally, in book form the manuals would cost you $325.)

By bringing forward all of the good NetWare features and building in scalability, NetWare 4.0 can give direction to and simplify your network environment, particularly if you are scaling up. Consider NetWare 4.0 for local, wide area, and global networking needs.

IBM Corp.

OS/2 LAN Server

BY KEN MACKIN

It's always been something of a given that you at least consider the product from IBM in any software or hardware category. For those of you ready to take the NOS gambit, you'll notice that OS/2 LAN Server, Version 3.0, provides most of the features that the other games here do—and some they don't—but this game also plays a bit differently.

How you place your bets in this one depends on your skill and risk profile. It also could depend on your corporate history—has your company been playing at the IBM table for a long time and for good reason? Is the IBM LAN game any different from the games at the Microsoft table? Although the tables may look similar, the games are different.

SUITABILITY TO TASK

OS/2 LAN Server

	POOR	FAIR	GOOD	EXCELLENT
Small network	●	●	●	○
Medium network	●	●	●	○
Medium to large network	●	●	●	○
Large enterprise network	●	●	●	○

IBM has taken pains to improve upon the LAN Manager architecture it purchased from Microsoft. IBM has rewritten much of the code, including the file system. It has updated some of the interface tools to take advantage of OS/2 2.*x* and Presentation Manager (PM), and added features that make administration of large LAN Server networks possible, unlike LAN Manager.

The results are somewhat above the break-even point. But although IBM has made LAN Server nearly as fast as NetWare 3.11, it has not played to full advantage its own Presentation Manager GUI. Most of the important tools run in OS/2 text mode. And although text mode works, why won't IBM demonstrate how powerful PM is? IBM could develop state-of-the-art object-oriented administration tools that allow for easy management of LAN Server networks large and small. No other network operating system has true

object-based tools, not even Advanced Server. It's an opportunity.

When you talk about LAN Server, remember that there are really two bets here: an Entry edition for $795, and the Advanced edition for $2,295. The Entry product is slower than the Advanced, and forgoes a number of tools needed to work in a large network environment—such as a ring-0 version of the HPFS file system and SMB sideband. We reviewed LAN Server Advanced, which included these features.

OS/2 LAN Server Advanced permits up to 1,000 users per domain compared with 1,000 for NetWare 4.0 and Advanced Server; 250 for NetWare 3.11; 70 for NetWare 2.2 (per server); 50 for LAN Manager; and 30 for VINES.

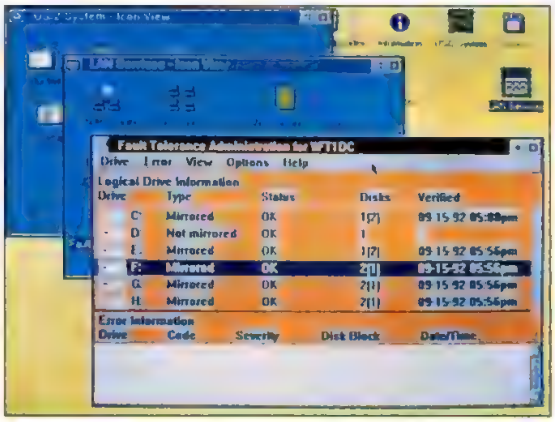
LAN Server's current release does not support any movement and reconfiguration of domains. So, if your company, for example, were to buy out the competitor and you wanted to recalibrate your network architecture to reflect the new regime, IBM supplies you with the full API to build your own tools. It says that companies big enough to need that kind of capability usually want to write their own, because they have customized environments to accommodate. But in fairness, none of the "domain type" NOSs has a solution to this problem.

Users in a domain can have access to aliases, remote applications (the OS/2 analogy to a Novell NLM or VAP), and Remote Initial Program Load (it loads operating system and device drivers on workstations without hard drives).

All of these features are set up and controlled in the OS/2 LAN Requester, the "croupier" of this NOS. LAN Requester is the main administration program, where resources are divvied up and security maintained, users defined, and statistics observed.

The OS/2 LAN Requester lets you redirect drives, check requester and server parameters, maintain Access Control Locks on files and directories, and determine the particulars of resource sharing, lamentably, using OS/2 text mode. The same program under PM could be very competitive. As it is, LAN Requester is consistent and has what you need to set up and maintain a network.

Users and groups can be configured and maintained there or in the OS/2 Workplace Shell using the User Profile Management Services (UPMS). The UPMS at first seems like a great program, but it cannot clone users. Although it works well, it's not very powerful. It appears at first as if you have to set up each user and group by hand. Actually that's not true. You can clone users, but you must use LANUSER2, which is supplied on the productivity disk, but is not identified in the regular LAN Server install.

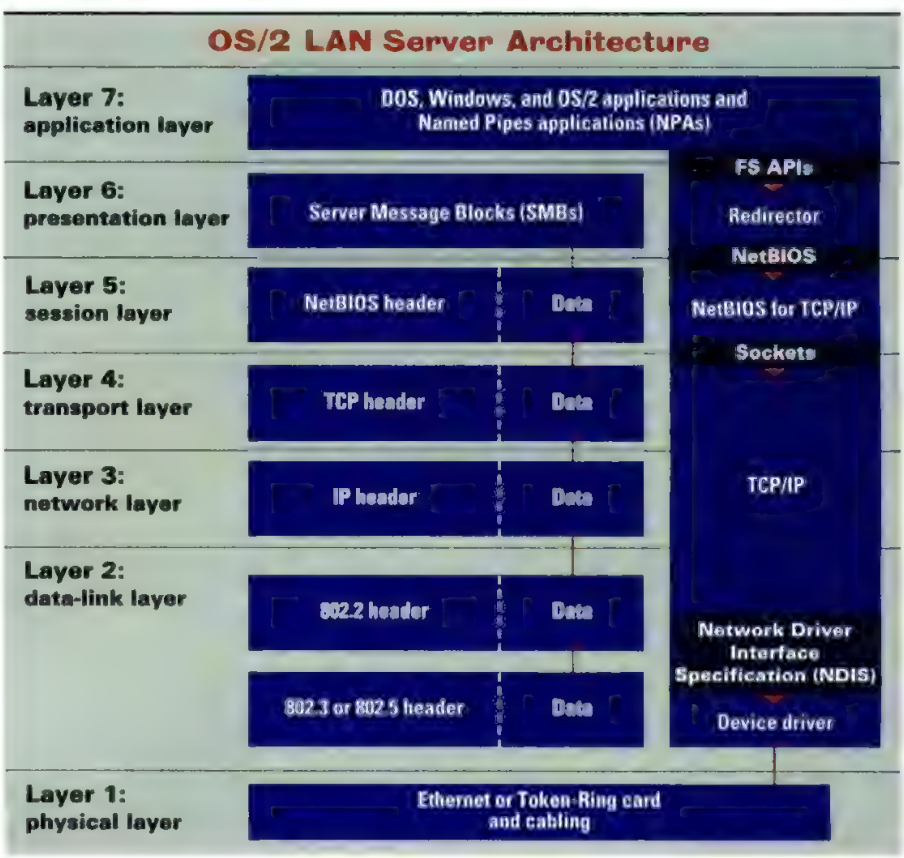


Network administration under LAN Server is accomplished, not surprisingly, under IBM's OS/2, but some is text-based.

This is an excellent example of the challenge that novice or even semi-pro networkers would have using LAN Server. It does so much, but its capabilities are rarely obvious. If you need a function, keep digging, it's probably there somewhere.

The on-line reference tools are powerful PM programs, but the switch between LAN Requester and the GUI On-Line and text-based Requester is disorienting. Although the GUI-based help is good—and the Command Reference excellent—only simple searches are allowed, as in Microsoft Windows. Only Novell thinks that it's important to include Boolean searching with its products.

Performance numbers on LAN Server put it near the top of the pack, behind NetWare 4.0 and VINES. Being neck and neck with NetWare 3.11 is quite an achievement for a large kernel OS such as LAN Server. The only twist is that lazy writes on the HPFS cache were stretched to 10 seconds to obtain that figure.



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What the Numbers Mean

Each of these network operating systems offers a different combination of rich features, expandability, and performance. For example, some NOSs are fine for basic file transfers but cannot handle the large loads that might reflect the demands of a growing enterprise network. You'll need a 32-bit NOS for any large networked environment.

Our tests gauge NOS performance in three areas related to file transfers. Specifically, we want to find any performance enhancements or degradations caused by NOS internal routing, discover if large hard disk caches are more or less advantageous than small hard disk caches, and see if different packet sizes affect the underlying communications protocols.

The total disk cache memory made available by the NOS plays a major role in enhancing a server's performance; other enhancements depend on how the client and server protocols negotiate the size of packets on the wire and the total number of packets within a frame. We evaluated the NOS protocols by monitoring the wire with Intel's NetSight Analyst protocol analyzer. Those that best negotiated the size and amount of packets per second on the wire were superior performers.

Moreover, a winning setup—one with a large disk cache that efficiently negotiates packet frame size—should offer the best performance. Products that support internal routing should have lower throughputs than products using external bridges. Servers that route internally honor file read and write requests over packet-routing requests; external bridges free the server from performing the routing function but are an additional expense in terms of cost and management.

BENCH PRESS

We constructed two test-beds for our review (see the accompanying diagram). We used one configuration to test products that perform packet routing between adapter cards within the same server (VINES 5.52(5) and NetWare 2.2, 3.11, and 4.0). We designed the other setup for NOSs that use unroutable protocols (OS/2 LAN Server 3.0, Microsoft LAN Manager 2.2, and Microsoft Windows NT with Advanced Server).

Each test-bed consisted of three Compaq Deskpro 486/33M PCs acting as file servers. Each server contained 32MB of RAM and one 330MB hard disk. We installed two Eagle NE3200 Ethernet adapters into each server, creating two separate LAN segments. For each segment, we used 3Com TP Link Builder FMS MAU unshielded twisted-pair Ethernet hubs. To test VINES and the three versions of NetWare, we added a third NE3200 adapter to each server via daisy-chained thin Ethernet cable to form a backbone segment. For all the other NOS tests, we used three Cabletron EMME local Ethernet bridges to join the six Ethernet segments. Both the backbone and bridge methods let clients from one segment access a server on a separate segment.

We used equal numbers of Compaq Deskpro E PCs and Deskpro 486/33M PCs as clients. Each PC contained a 3Com 509 Ethernet adapter and 4MB of RAM. Each server had two PCs on each segment: one local client and one remote client to another server, which communicated through internal routing or external bridging. The load presented to each server thus appeared as two local clients and two remote clients, for a total of four.

We used ZD Labs' NetBench, Version 2.06, to test file-transfer performance. Version 2.06 lets us adjust the block sizes for read and write operations from each client, letting us see how the protocols handle different sizes. Larger block sizes negate the effect of local buffering at the client and force the OS to send varying packet sizes over the wire.

One iteration of our test sends a 1MB file from each client to its respective servers using 512-byte, 1,024-byte, 1,500-byte, and 4,096-byte packets. A second test run uses the same packet sizes but sends a 4MB file. The 16MB of aggregate data used in the second run puts stress on NOSs that use less than 16MB of RAM for their disk caching.

HITTING THE HIGH NOTES

To ensure peak performance, we optimized each product for our tests. VINES supported the entire 32MB of server RAM, which let us increase the available communications buffers. We also set communications buffers in VINES' clients via Banyan's PCCONFIG utility. VINES uses a licensed version of FTP Software's IP protocol that lets clients and servers communicate with each other. VINES forced the data written from cache more often than the other products did, which slowed its relative performance.

NetWare 3.11 and NetWare 4.0 support system RAM well above 32MB. NetWare versions using the Intel 386 CPU's 32-bit instructions can also use up to 85 percent of the available RAM for disk caching. NetWare 2.2's 16-bit design limits the size of the disk cache, however, and affected its throughput on our 4MB file transfers.

Novell's latest IPX burst-mode protocols showed significant performance increases as clients and servers negotiated multipacket frame sizes through bridges and routers. In addition, Novell has released its Large Internet Packet (LIP) protocol, which removes the 512-byte ceiling for internet packets and allows any packet size to route between segments.

To get the best performance from Novell's 32-bit NOSs, we increased the minimum and maximum receive buff-

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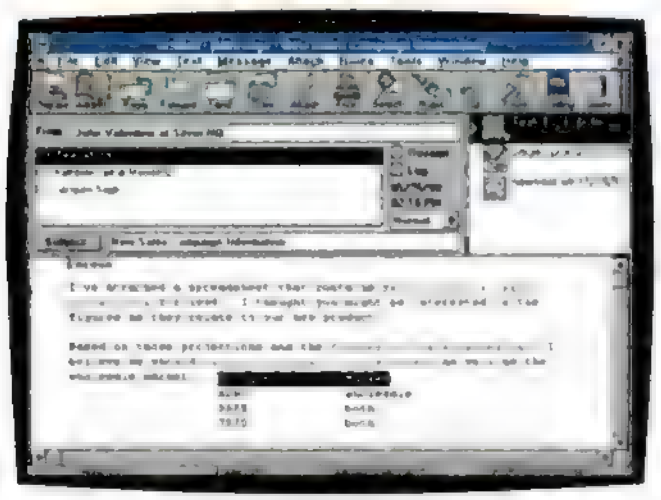

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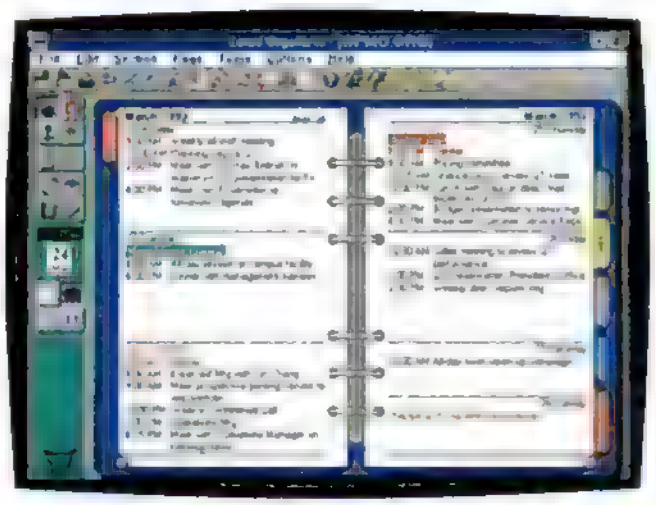

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Benchmark Tests: Network Operating Systems

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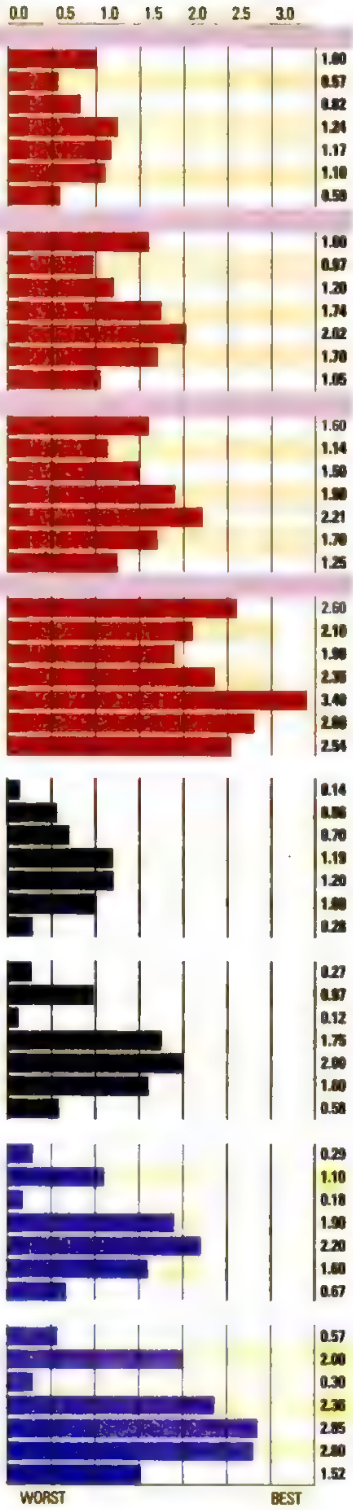
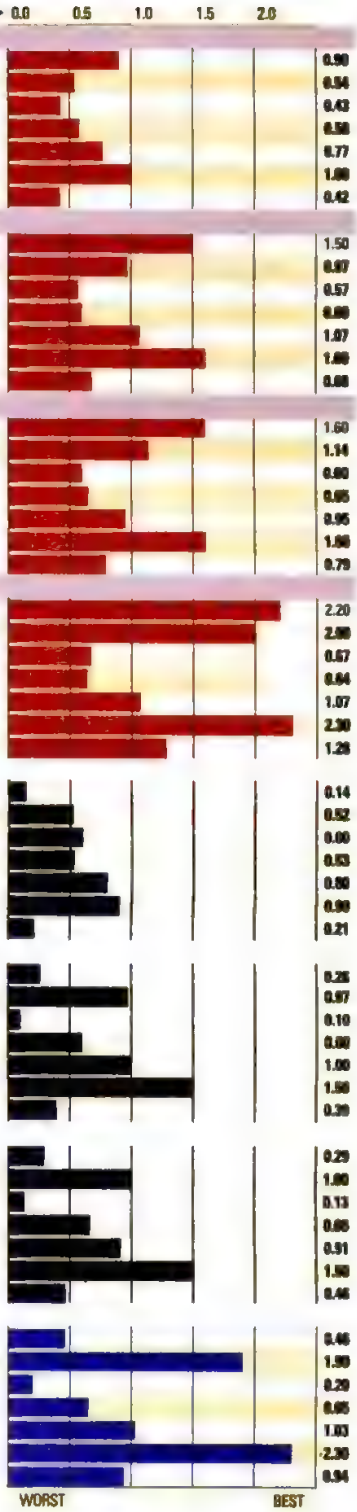
LOCAL FILE TRANSFER



REMOTE FILE TRANSFER



ers to their highest levels. We set the maximum physical receive packet size to its largest value—1,514 bytes for Ethernet. Doing so meant the IPX protocol would handle the larger packet sizes created from NetBench without breaking the packets down.

NetWare disk volumes also let you set the fixed block size for file allocations. With an 8K block size, even a 1-byte file would use 8K of disk space. NetWare 4.0 defaults to the 64K block size, which increases the amount of data written to the disk in a single write request. We set the NetWare 3.11 server to the 64K block size for compatibility reasons; most users moving from NetWare 3.11 to NetWare 4.0 would choose a 32K or 64K block size.

We also tested the Virtual Loadable Modules (VLMs) client software from NetWare 4.0 with the NetWare 3.11 server. Novell also offers packet burst (via PBURST) and LIP for NetWare 3.11 in an add-on package with its NetWare MultiProtocol Router. PBURST permits packet negotiation between the server and client; instead of an acknowledgement for every data packet, PBURST provides a series of data packets for every acknowledgement. LIP lets packets larger than 512 bytes route between internal segments.

LAN Manager also has a limitation: a 16MB server RAM limitation. Microsoft did replace OS/2 1.3's HPFS with HPFS386 for LAN Manager. This enhancement to HPFS allows for a larger disk cache, which helped improve performance in servicing file requests. LAN Manager performed well on the 1MB file-transfer test with the larger packet sizes because it used NetBEUI.

LAN Manager, LAN Server, and Windows NT with Advanced Server all use NetBEUI. Because NetBEUI transfers requests in 64-byte packets, products using this protocol have an advantage for data transfers in our 4MB tests.

Advanced Server uses NetBEUI when dynamically changing the OS environment, by allocating the "numrecbufs" as needed at the file server. Instead of shutting down the server and reconfiguring the system, Advanced Server restructures itself during normal operation. Able to access the full 32MB of server RAM, it exhibited good throughput on our 4MB tests because of the additional cache. Its scores fell short of NetWare 3.11 and 4.0's numbers, however, because the basic Windows NT OS uses up to 8MB more RAM just for the OS.

LAN Server also uses NetBEUI to transfer data over the wire, and IBM adds some of its own technology to NetBEUI, such as automatically negotiating the number of outstanding packets by listening to the wire for traffic. Clients that find light traffic send large bursts of packets and throttle back as LAN traffic increases. LAN Server resides on the 32-bit OS/2 2.1. And as with other OS/2-based NOSs, we noticed that even with lazy writes set to On, the server's hard disk was accessed continuously. This increased server utilization, which slowed data throughput. We used the option to decrease the time the OS needed to write to disk from the cache, increasing throughput by 10 percent.

THE RESULTS ARE IN

Small, 512- and 1,024-byte packets increased the stress on each server's CPU as more requests became queued, limiting overall throughput. NetWare 3.11 and NetWare 4.0 performed best when servicing small-packet requests. We measured VINES' CPU utilization at 80 percent during the 512-byte packet tests, while NetWare reached 50 percent utilization. Products with higher throughputs tended to have lower CPU utilization.

The data throughput increased with packet size, since more data was transferred within a single packet up to Ethernet's maximum packet size of 1.5K. All NetBEUI users negotiated the number of outstanding packets using one server acknowledgement to the client. Novell's products offered the best data throughput because of efficient hard disk caching and packet-burst technologies. Although Banyan's protocol uses a streaming-packet method, we found that the CPU percentage was very high for all our tests, showing that the forced writes to disk created added overhead on the server CPU.

CLIENT TESTING

LAN Manager and LAN Server required external equipment to forward packets to another segment. Without the extra overhead placed on the OS for routing packets within the server, IBM and Microsoft clients both had excellent results through the Cabletron bridges.

Only the NetWare versions and VINES support internal routing within the file servers, but our test results suggest that network managers should not use internal routing unless their budgets don't allow for the purchase of external connectivity devices. The performance results for the internal-router products showed that NetWare's OS performed better with smaller packet sizes.

As the packet size increased, however, VINES was able to keep from fragmenting the packet into segments smaller than 1,500 bytes. Our monitoring of the backbone segment showed that NetWare 4.0 using LIP did at times route the packet at 1,500-byte frame sizes, but more often the packets were fragmented down to 512 bytes. The LIP algorithm was not able to maintain the larger packet sizes between segments when faced with the extremes of testing.

During NetWare 3.11 internal routing, we didn't see much difference between standard IPX and the streaming method offered by PBURST. This was because NetWare 3.11 would only internally route a packet between segments using a 512-byte packet size. Adding the LIP NLM should have increased throughput for PBURST by allowing for larger internet packet sizes.

When using 4MB files, NOSs with limited caches (LAN Manager and NetWare 2.2) soon used them up, sacrificing throughput. All the NetBEUI-based NOS test results are tightly clustered, with LAN Manager leading the crowd. Novell's 32-bit offerings, which use the burst-mode protocols, performed best. VINES performed well with small files, but it quickly used up its cache, yielding poor performance numbers with large files.

FACT FILE

OS/2 LAN Server, Version 3.0
IBM Corp., Old Orchard Rd., Armonk, NY 10504; 800-426-2968, 914-765-1900

List price: Advanced edition, $2,295; Entry edition, $795. Requesters, $75 each
Server requirements: 386-based PC or better, 9MB RAM (2.5MB for Entry edition), 7.2MB–8.2MB hard disk space
In short: OS/2 LAN Server's limited implementation of OS/2's Presentation Manager and the sometimes difficult administration and documentation overshadow an otherwise fast, powerful NOS. The OS/2 LAN Requester, a fine central administration program, delivers all the goods but would be very competitive if written for PM. With lots of what you need in the way of networking in the Advanced edition, including a domain architecture, OS/2 LAN Server is a reasonable pick
506 ON READER SERVICE CARD

The tests performed were based on one network card per segment, while LAN Server supports four network cards on the same segment—all communicating via NetBIOS to a particular station. The system even balances the load between the network cards. IBM says that it can max out the 16MB Token-Ring bandwidth using only a single properly configured server.

LAN Server is a powerful NOS with many of the tools needed to run a network large or small. At $2,295 per server, with up to 254 users per segment, for a total of a 1,000 log-ons, LAN Server offers plenty. The Entry level for $795 is one of the best deals in networking. Although slower and as tricky to configure as its big brother, the Entry level is a lot of networking for the price.

If IBM could only reorganize the table so that network gamblers could get into the game more quickly, the chips would have a chance of piling up.

Banyan Systems Inc.

VINES

BY ROBERT SPARRE

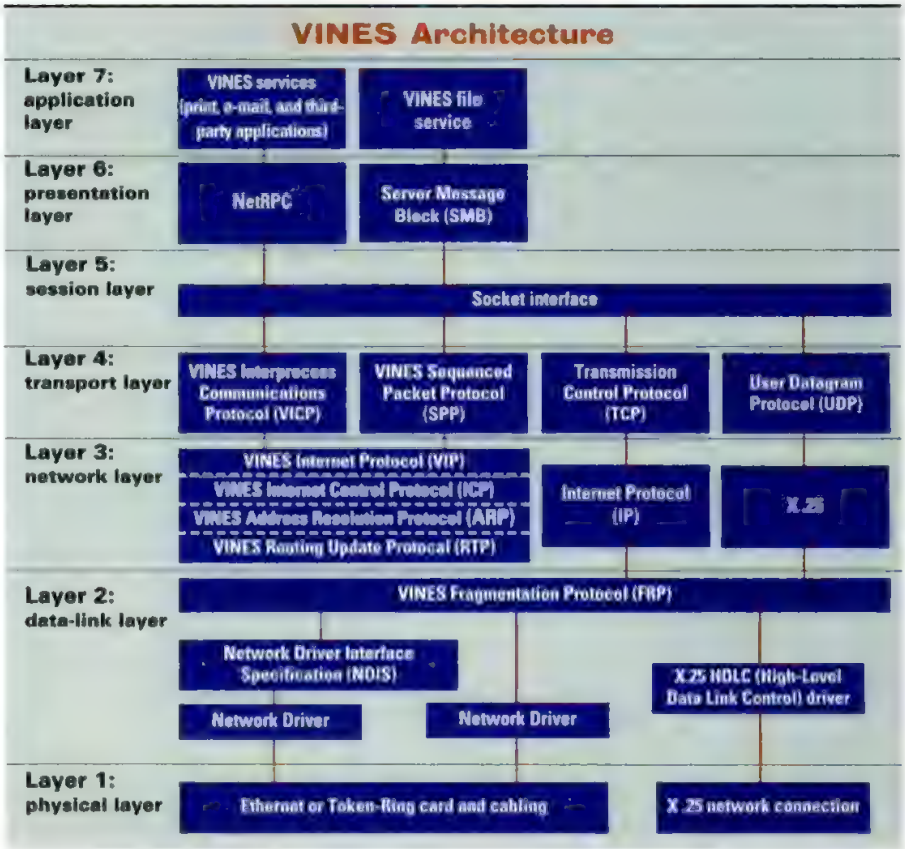
For a long time now in the networking world, VINES (for VIrtual NEtwork System) has been a compelling though complex risk—with high payoffs—for businesses that maintain global connectivity. With the release of VINES, Version 5.52 (5), Banyan Systems continues to stack the deck in favor of administrators of large enterprise networks with StreetTalk III, the third generation of the powerful VINES distributed directory services; improved mail and print services; and excellent administrative tools. Its lack of server fault tolerance keeps some otherwise interested LAN managers holding onto their chips, and it lagged behind the other enterprise-class NOSs in our performance testing.

Even for the new LAN administrator, building a VINES network does not require major resources in time or training.

Even for the new LAN administrator, building a VINES network does not require major resources in time or training. Setting up servers is a menu-driven process, and VINES's excellent administrative tools allow a wide range of choices in security features.

With StreetTalk III's Directory Assistance (STDA), a local copy of resources is available to end users, administrators, and applications. This gives instant access to information about the network without the need for wide-area network queries. StreetTalk III can now contain information in the form of objects on any resource. These extended attributes can be a picture of the user, a description of X.500 addressing, or a printer model and installed fonts. STDA can now get this data from StreetTalk so that a user, for example, can pop up a picture and paste it into an application.

Banyan has also dramatically improved the VINES mail engine. Mail now runs as a multithreaded service, so that messages with complex addressing for distribution to remote sites do not keep normal messages from being proc-



Fresh Help for Pathworks

by Stuart M. Hershkowitz

If you've been adventurous in the NOS casino and you have the mixed bag of server configurations on your network to prove it, take a look at Digital Equipment Corp.'s Pathworks, Version 5.0, for some help in tracking your server resources (due out late this year). But don't expect it to replace your NOS's administration program just yet.

Digital's package will offer multivendor NOS management with user-friendly icons; automated installation and configuration; a configuration, monitoring, and tuning utility for Pathworks OpenVMS servers; simultaneous loading of NetBEUI, IPX, DECnet, LAT, and TCP/IP; a faster TCP/IP transport stack; and interconnectivity to NetWare, Pathworks, and Microsoft LAN Manager LANs.

We installed Digital's beta version of Pathworks on a client simultaneously administering a LAN Manager server and a NetWare 3.11 server. We could preview Digital's client software without installing a Pathworks host because, unlike most of the NOS vendor community, Digital sells its NOS and client shells separately.

Pathworks program group, which is created during installation, holds Pathworks' connectivity and administration tools. The Pathworks Manager displayed all workstation resources in an easy-to-use viewer called the Browser. LAN Manager domains, NetWare servers, local disks, and printers were all easily accessible.

The icons for Browser components are intuitive, and single mouse clicks expand Browser items to display more selection depth.

We could view server information, edit the system log-on script, and enable or disable the user log-on as well as the Transaction Tracking System. We could also administer LAN Manager servers, file services, print queues, users, and groups.

As with most beta software, previewing Pathworks was not without technical glitches. Digital did not supply host software for this preview, so a preview of DECnet-specific utilities, such as the link into DEC VAXmail, was not possible.

The biggest drawback to Pathworks was its incomplete design: It cannot fully replace either SYSCON and PCONSOLE or NETADMIN. And any NOS-independent management tool that forces an administrator to use other management tools offers no significant benefit.

Specifically, for LAN Manager, Pathworks could not change the role of a server or invoke auditing. The most glaring omissions were print-queue management, share creation, and the ability to attach or detach from used resources.

Similarly, Digital abbreviates NetWare management: Supervisors have no control over account and station restrictions, intruder detection and lockout, or assignment of console operators and workgroup managers. Neither can they give trustee assignments to groups. You can manage print queues but not print servers, and the server's AUTOEXEC.BAT was out of reach.

Even with its deficiencies and missing pieces, Pathworks holds great promise. It has an intuitive graphical approach for managing a complex mix of software. Until it can replace the management tools of NetWare and LAN Manager, however, it remains primarily for Pathworks administrators or multiple LAN users. □

essed and delivered. Support for new options such as priority and deferred mail add powerful flexibility. VINES mail always has been a robust application, because it is so well integrated with StreetTalk—eliminating the need for a mail administrator. Neither is there a need to add users or log on to the mail system, because it is automatically synchronized with the StreetTalk directory service. However, for integration with foreign mail systems, Banyan's Simple Mail Transfer Protocol (SMTP) mail gateway is functionally weak. You'll have to look to third-party solutions for more robust capabilities, such as support for binary attachments.

Banyan's multiserver integration couldn't be simpler. The only task with a new server is connection to the network. StreetTalk takes care of distributing resource and topology (routing) information to the new server. Wide area connections, such as asynchronous dial-up, may require some configuration—supplying a phone number, for instance.

Support for modems also has been a sore spot for many customers, and improvements have been slow in coming. Hayes and Telebit Corp. are the only specifically supported vendors, and initialization strings on the server side are hard-coded. This leaves little flexibility for the user in making equipment selections. Although there is more flexibility in writing modem scripts on the PC side for client dial-up, it is not effortless and you may require assistance from someone with data communications experience. Banyan says it will address customer demands in this area.

VINES supports up to four NICs per server for any topology; configuration is accomplished through simple menus. VINES automatically takes care of any protocol binding and translations re-

SUITABILITY TO TASK

VINES

	POOR	FAIR	GOOD	EXCELLENT
Small network	●	●	●	○
Medium network	●	●	●	●
Medium to large network	●	●	●	●
Large enterprise network	●	●	●	●

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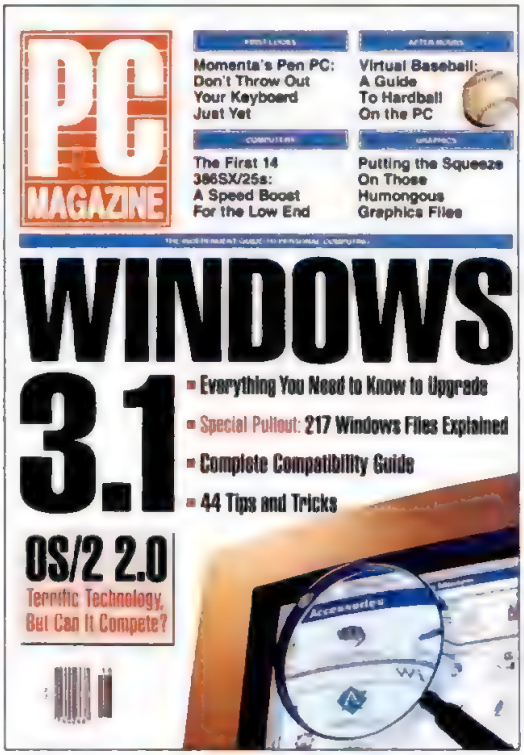

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VINES's straightforward character-based interface lets administrators manage user accounts across a WAN fairly easily.

quired between the NICs for routing to different LAN segments and topologies. Network management tools that are built-in to the console—and available from the client with the VINES Network System Management module ($995)—allow the administrator to see quickly any problems with a NIC that are based on input or output errors, dropped packets, and so on.

On the client side, Banyan is no longer developing native VINES drivers, having stated that NDIS is its client driver solution for the future (Banyan will maintain the drivers it already has developed). NDIS has been the curse of many administrators because of the complexity it adds in configuration and support over simpler native drivers, and information on the practical configuration of NDIS drivers has been sorely lacking in most vendors' manuals. Banyan has been improving its NDIS documentation, and the latest manuals excel in this area. Despite this, many users prefer and have turned to packet drivers, which have proven to be simpler to configure and support, and are also superior performers.

VINES provides adequate monitoring and tuning tools, but for large, centrally managed information system administration, you'll want some additional tools, such as Banyan's SNMP agent. The latest release, Banyan SNMP Agent, Version 2.0 ($695), allows active control of servers via the SNMP SET command, so that parameters such as cache and buffer sizes can be adjusted from the SNMP management station.

Network printing has been less than stellar over the years with VINES, but some rather impressive options have emerged. The number of print queues per server has increased to 20, and VINES supports more than one printer per queue.

In addition, two new LAN-attached printing options have been introduced. Developed in cooperation with Digital Products, they support any printer using Hewlett-Packard's Modular I/O slot, or you can select the standalone device, which allows any parallel or serial printer to be used. Third-party and shareware software products are also available for using TCP/IP-attached printers, such as HP's JetDirect card, or redirecting VINES print queues to any existing Unix print queue on another host.

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FACT FILE

VINES, Version 5.52(5)
Banyan Systems Inc., 120 Flanders Rd., Westboro, MA 01581; 800-828-2404, 508-898-1000; fax, 508-898-1755

List price: 5 users, $1,495; 10 users, $2,895; 20 users, $4,595; unlimited users, $8,495. AppleTalk option, $1,995.

Server requirements: 386-based PC or better, 4MB RAM, 4MB hard disk space.

In short: VINES delivers impressive large network integration and interoperability, in part through the third generation of StreetTalk (III), its fine global directory service. VINES offers excellent security, symmetric multiprocessing, open-standards integration, and reliability, but continues to take a hit for its lack of fault tolerance. Long-time users say they are beginning to get the company's attention in electronic forums.

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Backup options and disk utilization have not been so well taken care of. The backup/restore menus have been improved, but still are not very clear for administrators who want to restore multiple files or directories. Scheduled backups also force a read verification, which doubles backup time and is not always wanted; you have to do the backup manually to turn off the read verification. Third-party solutions can back up user data and some StreetTalk information across the network, but APIs for backing up and restoring the full StreetTalk database do not exist.

This leaves the server-based backup as the only robust source for rebuilding a server. VINES has no disk quota system to limit user disk consumption, nor any compression or archiving schemes. Again, third-party options are available, but clearly this function should be built-in to the base OS.

VINES's maturity in multiserver network design continues to place it at the top of the extended network deck, despite the inroads being made by other NOSs. Coupled with Banyan's newly demonstrated openness (especially on electronic forums) and customer focus, VINES offers some of the most impressive connectivity options in the industry for both new and existing networks. □

PC MAGAZINE

Network Edition

THE LATEST NETWORK PRODUCTS AND MANAGEMENT TECHNIQUES

Is Your NOS the Right Tool For Life in a Distributed World?

So it's finally time to make the big move and leap headlong into the wide world of distributed computing. You know your needs. You know your applications. Now it's time for you to go out there and just start coding.

By Michael D. Millikin

If you're like most developers, you'll probably end up writing for the network operating system already installed in your office. But how well does your present system, or even a new network operating system like Windows NT Advanced Server, fit into your plans?

Now, thanks to developments in the processor and software industries, building distributed applications is more appealing than ever. The skyrocketing power and decreasing prices of new processors like PowerPC, other RISC chips, and Pentium bring affordable processing power to the desktop. Also important are the advent of Windows NT, new versions of Unix and OS/2, and the various combinations of platforms and tools from companies such as Novell (NetWare 4.0, UnixWare, and AppWare) and PowerOpen. Network operating systems (NOSs), although typified early in their history by a focus on resource sharing, now also offer support for a more broadly functional distributed environment. The quality of this support can be an important buying factor in selecting the right NOS for a distributed computing environment.

Each NOS has specific strengths and weaknesses, but the weaknesses can often be overcome by the use of third-party

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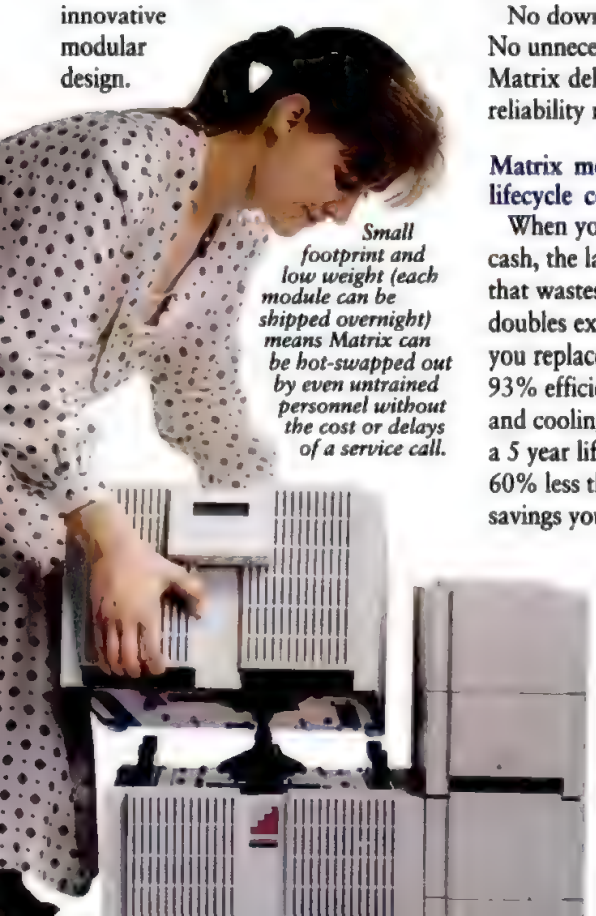
When we asked our engi
with 100% uptime and 6
they went

Introducing Matrix UPS
Modular protection for the client/server WAN

The challenge: eliminate the tough installation, burdensome service contracts, high lifecycle costs and threat of a single point failure that plague existing midrange UPSes.

The solution: Go to pieces. Package premium power protection in an innovative modular design.



Small footprint and low weight (each module can be shipped overnight) means Matrix can be hot-swapped out by even untrained personnel without the cost or delays of a service call.

Matrix modularity means reliability

In some midrange UPSes, a small internal failure can bring down the whole UPS, and your system with it.

In contrast, the Matrix- "100% Uptime" design isolates any problems to their 'block' which can be diagnosed and hot swapped-out while the protected system stays up and reliable.

No downtime. No service delays. No unnecessary risk. The fact is, Matrix delivers plug-and-play reliability no other UPS can match.

Matrix modularity means low lifecycle costs

When you're rightsizing to conserve cash, the last thing you need is a UPS that wastes it. Matrix modularity doubles expected battery life, saving you replacement costs, and operates at 93% efficiency, so you save electricity and cooling costs as well. In fact, over a 5 year lifecycle, Matrix costs up to 60% less than same-sized UPSes... savings you can't afford to ignore.

ISOLATION MODULE

Provides unmatched power protection and full VA capacity of multiple loads, even while in bypass.

Unlike older ferro-based designs, Matrix is compatible with servers which employ power-factor corrected power supplies. Standard 3-wire 208V input means no re-wiring

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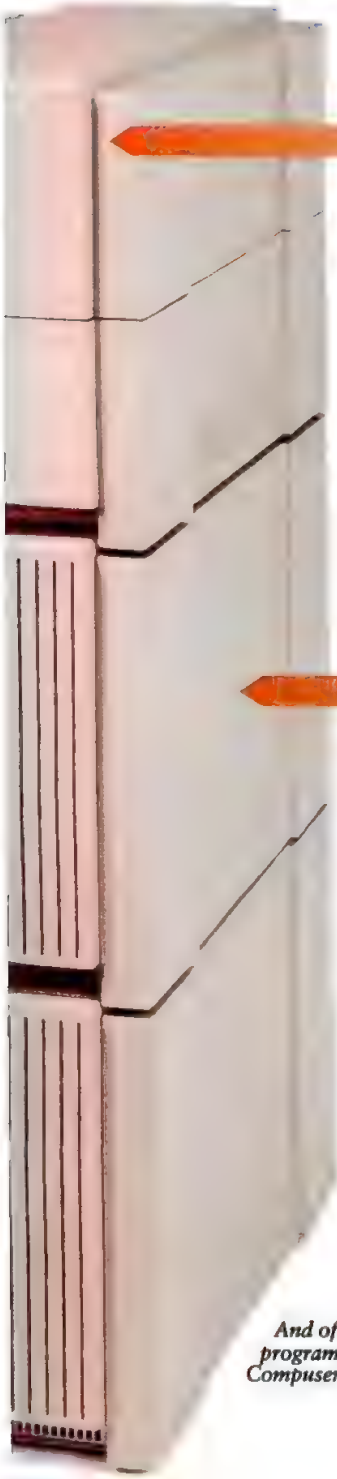

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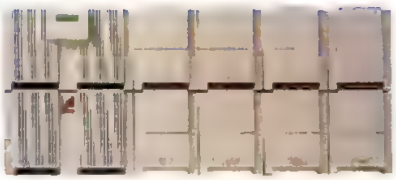


Need more runtime? Add SmartCells—in seconds with no need to take system down.

Microprocessor-controlled, self-diagnosing, zero-maintenance SmartCells end expensive service contracts.

For multiple servers...

Systems	Stnd * Matrix	Stnd Runtime
10 Compaq SystemPros	5000	10 minutes
10 RS/6000s w/ 19" mon.	5000	10
15 386/33s w/VGA	5000	10
4 Sun 4/490s	5000	11

For midrange systems...

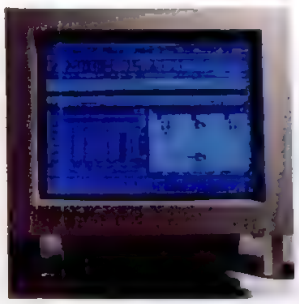
Systems	Stnd Matrix	Stnd Runtime
2 DEC Vax 4000-500s	3000	12 minutes
3 HP 9000s	5000	11
IBM AS/400	3000	13
inc:9406 E45 proc., 9337 DASD, 7208 tape, 3477 dis.		

* Shown as standard configuration. For additional runtime, simply add more SmartCells.

Electronics Module

Matrix offers a control panel in four languages, plus programmable output voltages, automatic bypass and more. Best of all, even the electronics module is completely hot-swappable for maximum system uptime.

Line-interactive design with online inverter means high-reliability, low operating costs. The unit's surge protection is backed by APC's $25,000 ABSOLUTE Downstream Protection Policy which will repair/replace any equipment damaged by a surge while protected by Matrix (see details).



Matrix provides auto-shutdown support of all major network, and midrange OS. The SNMP-compatible Matrix also supports APC's Measure-UPS which meters temperature and humidity, and monitors smoke, fire, water, and security detectors.

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products. IBM's LAN Server, based on OS/2, is particularly well-suited to distributed applications. Windows NT shares many favorable architectural features with OS/2, but Windows NT is just now developing third-party support. Unix-based NOSs and Novell's NetWare enjoy excellent third-party support, but Unix is sold by hundreds of vendors in different versions, which causes compatibility problems, while NetWare's friendly architecture poses some danger in environments where multiple applications from multiple vendors run on one server. In order to understand which features support distributed computing, we have to look at how applications function and how those functions can work across the network.

A DISTRIBUTED MODEL

In general, the term *distributed computing* describes an environment in which processes, resources, and computers strewn across a network work together to perform their tasks. This environment encompasses much more than just resource-sharing processes such as file service: It includes the distribution of the user's display, of application logic, of data, and of supporting services across the network. When these application components are broken apart and distributed across the network, they can operate more efficiently.

It is possible to cleave an application at any one of the three basic points: display, logical processing, or data. For example, X Window is a networked windowing system developed by a consortium of Unix vendors that shares the resources of a networked graphics display system.

Under X Window, a powerful processor with only a limited graphics capability has the ability to generate detailed images on a specialized graphics terminal across the network.

Some client/server database systems (such as Sybase) use networked calls between programs, referred to as remote procedure calls (RPCs), to distribute logical processing tasks over the network. For example, IBM is taking advantage of OS/2 distributed applications in its new DB2/2 mainframe database system.

There are many different ways of designing a distributed application, and there are essentially three basic higher-level mechanisms for distributing application logic: Transaction-oriented conversational mechanisms such as IBM's Advanced Program-to-Program Communications (APPC), RPCs available from every major system vendor, and distributed messaging such as IBM's Message Queuing Interface and Digital's DEC MessageQ. Third-party middleware solutions also implement distributed messaging.

A low-level message-passing mechanism that receives, stores, and forwards networked calls for services is suited for bulk data transfer, while an RPC is mainly used in request-response client/server applications such as ordering and inventory. A good analogy is that of a transportation system. While a 747 is an excellent solution for trans-Pacific freight, it's not all that hot for zipping out to your favorite pizza place.

A Comparison of Distributed Features

This chart describes the basic and advanced distributed-computing capabilities found in five popular network operating systems. The basic capabilities are briefly described below, while the advanced capabilities are discussed in the text.

■ Operating systems designed for distributed computing require preemptive multitasking and multithreading.

■ Priority-based dispatching allows servers to regulate delivery or response based on a client's priority.

■ Synchronization mechanisms (called semaphores) and intertask protection manage access to shared resources.

■ Memory management includes protection, demand paging, and efficient support for very large data objects and programs.

■ Interprocess communications mechanisms handle the work of distribution. The OS should support both local and remote interprocess communications with a variety of levels of accessibility, providing a sockets interface, for example, as well as a higher-level messaging API.

■ Database and transaction services should be supported by an operating system or interprocess communications mechanism (such as Transarc's Transactional RPC) that understands the requirements of a commercial transaction.

■ Other distributed computing services include a high-performance file system, efficient memory management, multiprotocol support, and several network services such as a time synchronization service, directory service, security service, and systems management and administration.

■ = YES □ = NO

	NetWare 3.11	NetWare 4.0	Unix	Windows NT Advanced Server	OS/2 LAN Server
Basic features					
Multitasking	■	■	■	■	■
Multithreading	■	■	■	■	■
Priority-based dispatching	□	□	■	■	■
Synchronization	■	■	■	■	■
Protected memory	□	■	■	■	■
High-performance file system	■	■	■	■	■
Dynamic run-time extensions	■	■	■	■	■
Extended features					
Multiprotocol support:					
TCP/IP	Add-on	Add-on	■	■	Add-on
APPC/LU6.2	Add-on	Add-on	Add-on	Add-on	Add-on
APPN	Add-on	Add-on	Add-on	□	Add-on
IPX/SPX	■	■	Add-on	Third-party	Add-on
NetBIOS	■	■	Add-on	■	■
OSI	Add-on	Add-on	Add-on	Third-party	Add-on
High-level interfaces:					
OSF/DCE RPC	□	□	■	■ (compatible)	Add-on
OSF/DCE Secure RPC	□	□	■	□	Add-on
Sun ONC RPC	■	■	■	Add-on	Add-on
Novell RPC	■	■	■	Add-on	Add-on
Messaging	Third-party	Third-party	Add-on	□	Add-on
Conversational	□	Add-on	Add-on	Add-on	Add-on
OLTP services	■	■	Add-on	Third-party	Add-on
Objects	Add-on	Add-on	Add-on	□	■

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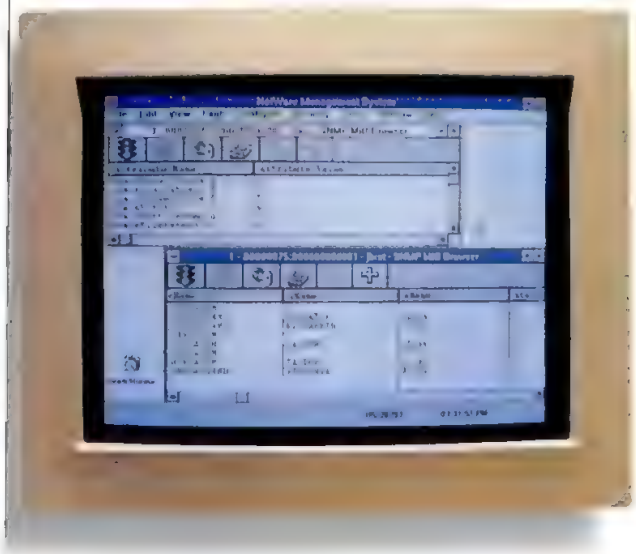

New York:
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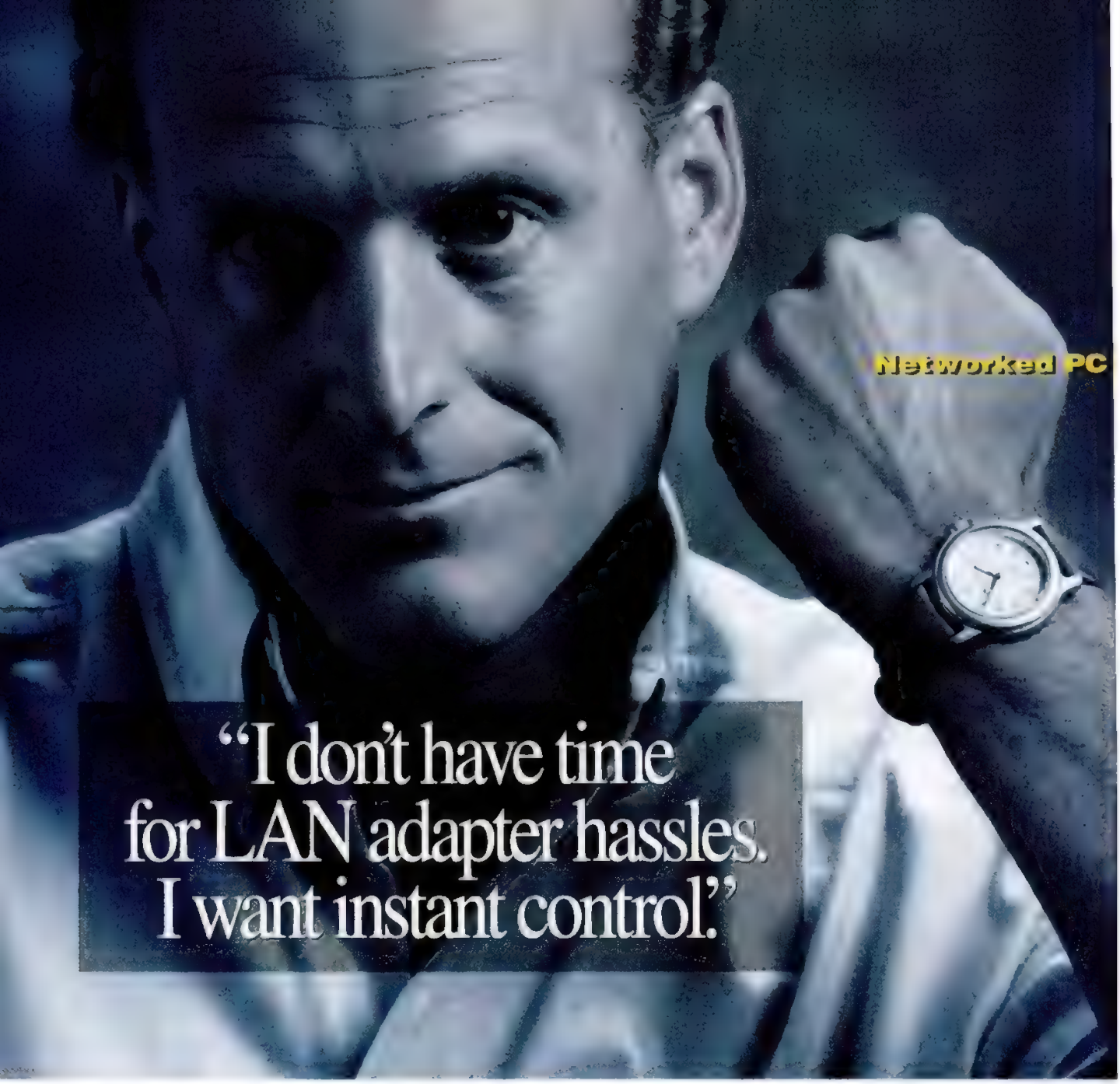

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hardware assets. Information that can also be centrally viewed using Intel's LANDesk™ Manager software.

The FlashC adapter even includes Intel FlashVirusProtect, which detects and corrects boot sector viruses, and guards against thousands of viruses on your PCs—from system memory to files stored on floppy and hard disks.

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It has a great memory, too. Actually, the EtherMeter has two kinds of memory: up to 4MB of RAM for storing multiple host/matrix tables of up to 64,000 entries, and a half meg of non-volatile flash memory for downloading future enhancements. Hey—any system that keeps its hands off your PC's RAM and protects your investment in hardware deserves your respect (or at least a demo).

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TRANSACTION-ORIENTED MECHANISMS

Conversational mechanisms enable two programs to establish a conversation to exchange data and status information. Examples of conversational application program interfaces include IBM's APPC and NetBIOS Extended User Interface (NetBEUI). NetBEUI is a primitive system that doesn't include the information needed for network routing.

APPC is one of the oldest and most familiar interfaces used for distributed computing. It was originally designed as a communications protocol for transaction applications such as reservation systems. Today, APPC is supported by all popular NOSs, though it is mostly closely integrated with IBM's OS/2 LAN Server. A rich set of services are provided, including security, naming, locking, logging, scheduling, recovery, end-to-end integrity, exception handling, and time control.

However, APPC is difficult to use, forcing developers to understand communications and to master the 32 different verbs with some 1,400 error conditions. There are also multiple implementations of APPC for IBM's different platforms, making mastering it all the more difficult.

IBM's Common Programming Interface-Communications provides a more consistent set of calls for APPC on the multiple platforms but still doesn't address the complexity issue, a problem solved only through third-party products.

REMOTE PROCEDURE CALLS

The RPC takes the familiar programming concept of calling a subroutine and applies it to a networked environment. Basically, the RPC code sends the parameters passed with the call to a remote subroutine for action. All popular NOSs have some RPC capabilities, but they aren't all interoperable (see "Middleware Revealed," *PC Magazine: Network Edition*, August 1993).

Using an RPC, a developer can call a subroutine that not only is on a remote node, but runs in a different operating system environment. RPC coding is straightforward because it doesn't require communications verbs. An RPC is a good choice for request/response programs such as database queries or programs that distribute work out to compute servers.

The initial implementation of RPCs was synchronous: After making a request, the client program would have to twiddle its thumbs until the return came back from the server. OS/2 and Windows/NT make RPCs more efficient. Work to deliver asynchronous RPCs that can recognize errors, but don't just wait for responses, is also underway.

Other limitations in RPCs include the need to prepare all data before the call, the inability to involve the application in error recovery, and the complicated mechanism for selecting the designated server.

Message-based distribution is a good technique for applications that can use queues, such as high-volume transaction processing applications.

Two trends have made RPCs better suited for transaction processing. First, the emergence of RPC compilers from third parties such as NetWise and HP. These compilers make it easier to write RPC-based applications and to extend the functionality of the basic RPC.

Second, multivendor distributed computing environments, such as the Open Software Federation Distributed Computing Environment (OSF/DCE) and Unix International's Atlas, provide a standard set of distributed services as well as an RPC that developers and third parties can expand. IBM, for one, will incorporate the OSF/DCE services into LAN Server, Version 4.0, in addition to offering a discrete DCE product.

Adding functionality on top of an agreed-upon platform is an important way to cut development time. Transarc built its Encina technology to support open systems–based distributed transaction processing on top of the OSF/DCE foundation. Unix Systems Laboratories (USL) is incorporating support for DCE services into its Tuxedo distributed transaction processing technology as well. USL is standardizing the DCE RPC interface for transaction processing environments under the name of TxRPC in the Tuxedo system.

Every major advanced operating system now offers some form of RPC support. More than 200 system vendors have licensed the Sun Open Network Computing RPC (ONC RPC). IBM and other major systems vendors also offer the OSF/DCE RPC. Microsoft is designing its own RPC, asserted to be OSF-compatible, for Windows NT. Novell offers the Sun ONC RPC, as do most Unix systems, plus the NetWise RPCTool, which works either with the Sun RPC or NetWise's own RPC.

MESSAGING

Message-passing offers a different model for distributing application control and data. Client applications put messages in a message queue maintained by the message software for another application and take responses from their own queues. Messaging is a flexible mechanism, allowing developers to defer delivery, support assured delivery, and provide recoverability. A distributed program based on messaging does not have to wait for its partner to return a response to its message. While all partners must be up and running for a conversational or RPC-based distributed application, messages offer a store-and-forward capability.

Messaging makes use of simple verbs, making programming easier, but unlike an RPC, a messaging mechanism does not automatically correlate requests and responses, so the higher-level software must track the messages sent and received. Message-based distribution is a good technique for applications that can use queues, such as electronic mail, reservation systems, and other high-volume transaction processing applications. But messaging is definitely not designed for real-time interactive computing or other situations in which an application requires the tight correlation of many small blocks of data.

Message-queuing products or middle-

ware can complement the other mechanisms. IBM's MQSeries and Distributed Application Environment, PeerLogic's Pipes, and exBridge by Systems Strategies are message products that can use APPC, for example.

A crop of third-party providers of middleware serves the needs of the distributed computing market. Some of the providers focus on a specific mechanism. Netwise, for example, has chosen to run with the RPC, as has Creative Systems Interfaces with its Application to Application Interface. These companies make products for Windows, OS/2, NetWare, and Unix-based operating systems. Many of these middleware solutions also offer the additional benefit of running on a mainframe operating system as well as on a LAN operating system.

THE OBJECT IS THE THING

PeerLogic and Horizon Strategies both point toward the future of distributed applications: distributed object systems and management. Essentially, developing distributed applications is still just too complex for widespread propagation of the technology. Called subroutines, for example, are great for well-defined problems, but much harder to use in a less fixed environment. Object-orientation provides a means to simplify the programming task. The trend toward object-oriented environments, systems, and development is converging with the trend towards distributed network computing environments.

IBM is already delivering beta versions of its Distributed Systems Object Model (DSOM, incorporated as part of the Systems Object Model 2.0 in OS/2). DSOM initially will manage communications between objects in workgroup environments. A graphical development tool that is provided with SOM 2.0 will allow developers to modify and to assemble SOM objects into distributed applications. A later release is going to add an enterprise-class directory, security, and other services from the OSF/DCE. The object services, in effect, run on top of the distributed computing services, including the RPC. DSOM utilizes a sockets interface to work with TCP/IP, NetBIOS, and IPX, and could also provide services for Taligent in the future.

Novell has a 20 percent interest in and technology partnership with Hyperdesk, the makers of Distributed Object Management System (HD-DOMS), which is compliant with the emerging standards of the Object Management Group. Novell also recently announced AppWare, a set of object programming tools (from acquisitions Software-Transformation and Serius) to support the creation of network applications.

Hewlett-Packard, IBM, and Sun are agreeing on a common object interface to support easier creation of distributed, object-oriented applications across multiple platforms. And then there is always Microsoft with is plans for Cairo—an object-oriented successor planned for the recently released Windows NT and Advanced Server.

AppWare is more than the vapor specification skeptics deem it—Novell has acquired companies and partnerships with the relevant technology.

While the convergence of object orientation and networking appears on track, it doesn't address today's needs. Developers need to make decisions now to develop and deploy their critical applications. In selecting a distribution mechanism, they have to pay attention to some of the considerations mentioned above, as well as some others such as system requirements, availability of middleware on multiple platforms, and connection-oriented mechanisms versus connectionless ones. Users and businesses don't like to wait. An elegant distributed computing architecture might make programming a great deal easier, but it also can add a lot of performance-choking layers.

SERVER CHOICES

Distributed computing takes a step beyond the resource sharing required from the bulk of current LANs. Four operating systems are jockeying for leadership in this emerging market: NetWare, the current leader; Unix; OS/2; and the newest, although most visible entrant, Windows NT. NetWare, originally optimized as a foundation for a file service, is seeking to extend its reach into other areas. The other operating systems, although technically general-purpose OSs, are being extended to provide optimized network services.

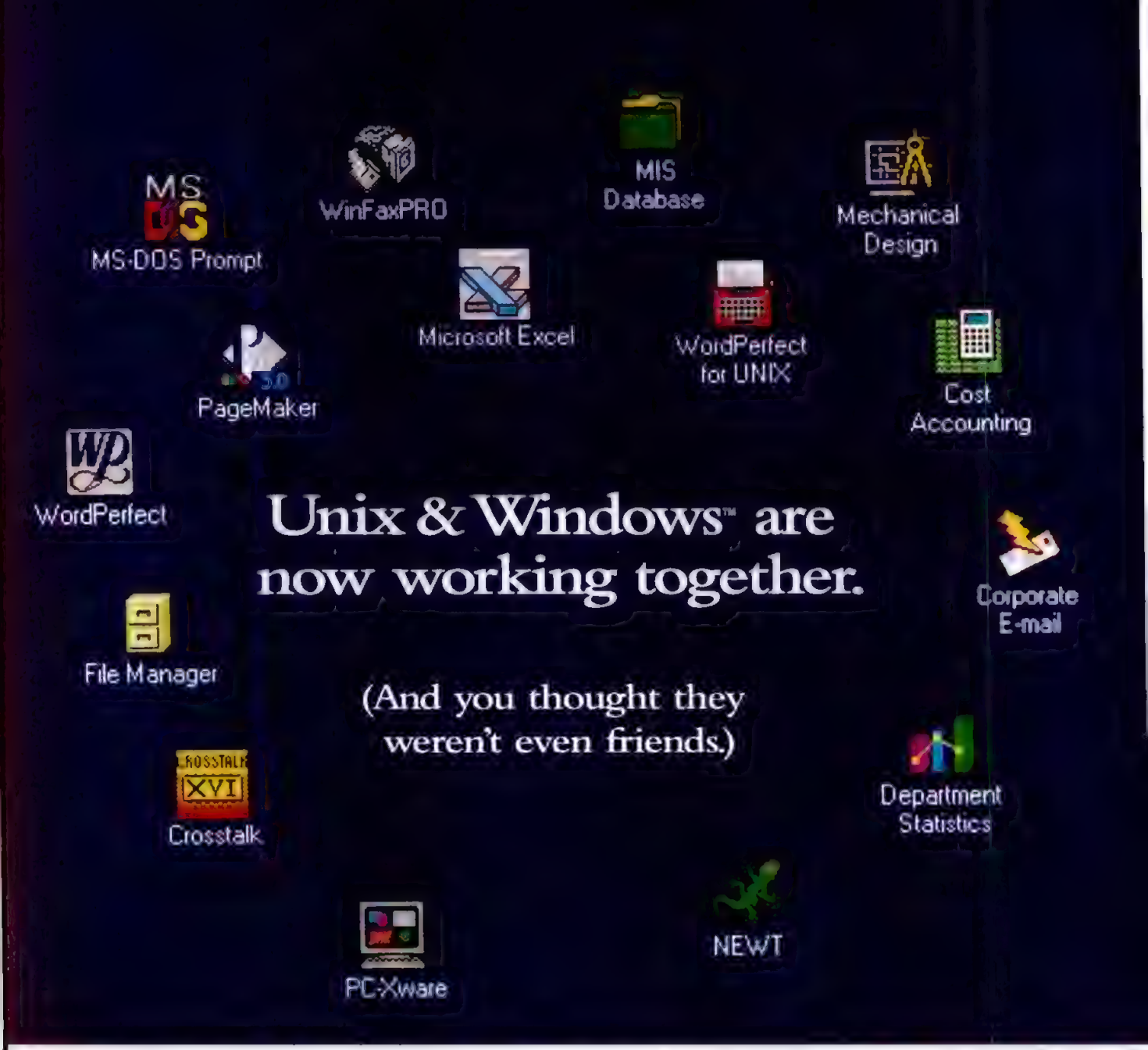
NETWARE 3.11 AND 4.0

Novell took heat about NetWare's unsuitability for advanced client/server computing until the release of NetWare 3.11 and the advent of NLMs. NLMs provide an important mechanism for adding programs that extend the function of the operating system kernel. NetWare's NLM structure enables Novell and a large (and still growing) number of third parties to extend NetWare's capabilities toward multiprotocol communications and middleware for distributed applications. PeerLogic, for example, delivers its Pipes platform as NLMs.

Neither NetWare 3.11 nor 4.0 offers preemptive multitasking or priority-based tasking. NetWare is designed as a performance-optimized special-purpose operating system. Novell justifies the lack of memory protection in NetWare 3.11 and earlier, or the lack of priority-based scheduling, by pointing to the performance hits such features could cause. Novell essentially takes a "nice guy" approach: NetWare assumes that NLMs will all be nice guys that won't crash the system or hog a thread of control. The combination of these factors puts an enormous burden on the developer to write bug-free and polite code.

Novell's AppWare is designed to solve the development problem. AppWare is actually more than the vapor specification skeptics might deem it—Novell has been assiduously acquiring both companies and partnerships with the relevant technology.

As the market for network applications continues to evolve over time, both tools and product families such as AppWare will entice developers to one platform rather than another, as opposed



Accessing a Unix application from your PC no longer means you have to leave the world of Microsoft Windows. That's because NCD has brought its leading X server technology to your PC.

It's called PC-Xware, and it's a Windows application. So it allows you to access both graphical X and character-based Unix applications in the same way you currently access, say, Excel. Or Word. And since the complexity of Unix is masked behind Windows icons, displaying a Unix application on your PC requires nothing more than a point and a click.

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to diminishing technical differences in the base operating system.

UNIX

Unix has been the historical favorite for advanced distributed systems work, especially when that work has consisted mainly of research projects. Unix is a mature operating system, and, as such, it offers the requisite support for both base and extended operating system services. Novell's acquisition of Unix gives the company a very strong set of options to address the needs of various segments of the market.

When you are talking about Unix as a server, it is important to identify exactly which provider of Unix you are dealing with and their accompanying extensions to the operating system. One very pragmatic reason for taking a close look at Unix as a platform for distributed applications is the incredible price/performance provided by the Unix/RISC combination. Add support for multiprocessing into the mix, and Unix-based systems can scale all the way up to the size that is needed for a data center without even breathing hard.

WINDOWS NT AND OS/2

Microsoft designed Windows NT as an operating system that would be a foundation element in a distributed system. It is an advanced operating system that incorporates all of the necessary communications elements for application distribution. It is portable, and also can ride the RISC platforms into the glass house.

The greatest current barrier to Windows NT as a platform for advanced, distributed applications is its youth. Windows NT hasn't been out long enough to generate the rich set of development tools for distributed applications that are only now beginning to appear on other platforms. Undoubtedly, those will appear. But in the absence of tools and other middleware from Microsoft and developers, developers will either have to wait or roll up their sleeves and use the elements in NT such as Microsoft's version of the OSF/DCE RPC.

OS/2 was initially designed as the client end of IBM's sprawling Systems Application Architecture, designed to provide interoperability across the board—between the PC, the midrange computer, and the mainframe. OS/2 still provides that function. Of all the operating systems here, it (naturally enough) pays closest attention to being an advanced client, peer, or server within an IBM environment. Increasingly, though, fulfilling that role has meant the incorporation of third-party or standard technology, such as the OSF/DCE.

On the bottom line, all of the popular network operating systems offer options for creating distributed applications. But some have specific capabilities or features that favor certain types of applications. Ultimately, the decision to select an operating system for a distributed application is going to be influenced by a number of nontechnical factors, including the installed base, available support, training, and tools.

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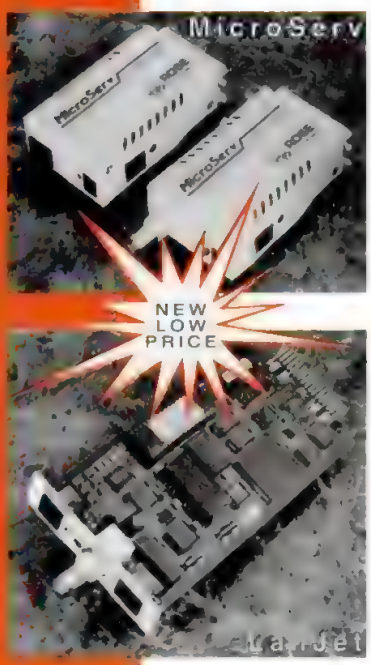

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yes
It runs with NetWare

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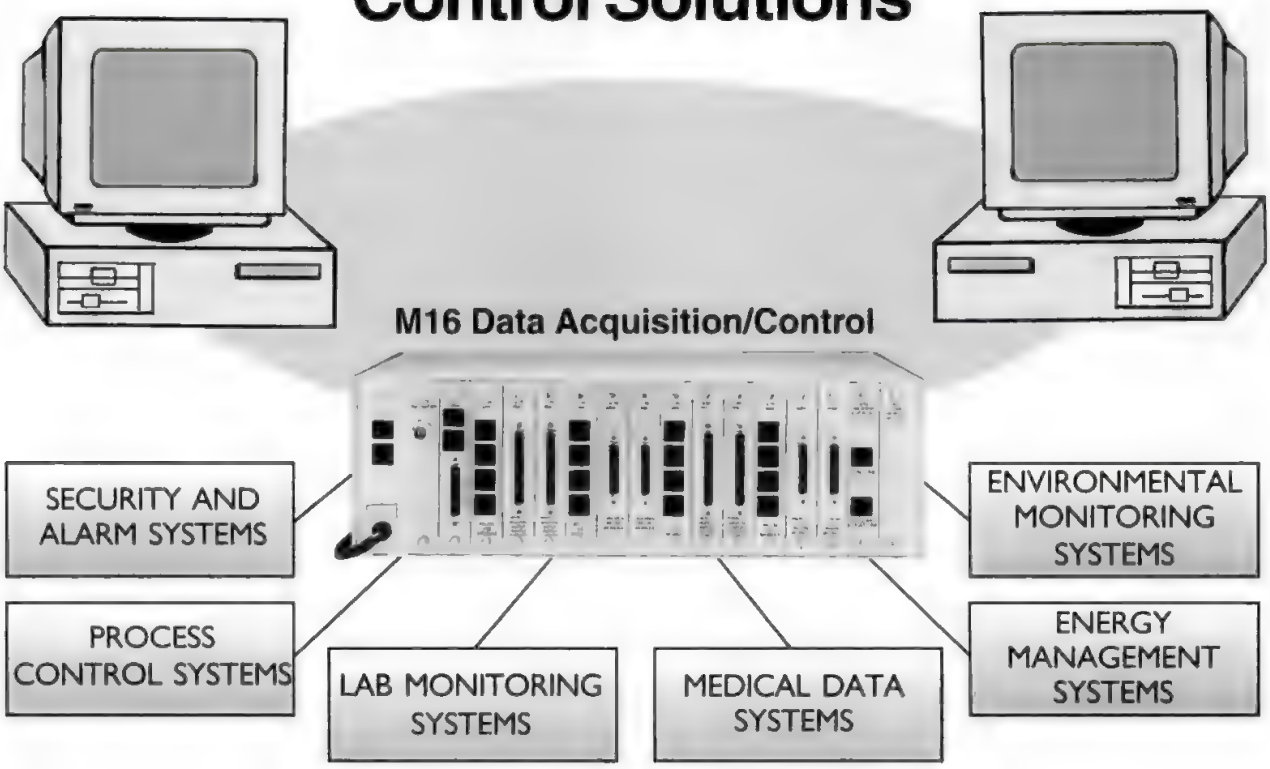

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- *RS-232/RS-422*
- *RS-485*

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- *Current Loop*

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Maximizing the Performance Of Your Server

Getting the most out of your server means more than fast processors, slick architectures, and glitzy hardware.

By Frank J. Derfler, Jr., and Max Schireson

Networks are for sharing, and the value of sharing is never as high as when you share devices such as hard disks. But how do you reap the best possible performance from your investment? How do you maximize the performance of a PC-based file server?

The most effective method is disk caching, the process of reducing the time required to service I/O requests by moving data from the relatively slow hard disk to high-speed memory. A more complex method involves finding and removing all of the bottlenecks inside and outside the server.

DISK CACHING

Over the past decade, processor speeds have increased fiftyfold. In contrast, disk access times have only improved threefold. As the gulf between disk I/O performance and processor performance widens, the importance of disk caching increases. Without disk caching, your sizzling new Pentium-equipped server with all its optimizations may simply be stacking up requests for data as it waits for the hard disk.

The most important task in optimizing your file server's performance is providing a cache large enough to keep your CPU and adapter busy. Since applications read consecutive blocks of data, when an application reads 2K of a database file, for example, a smart caching program will pick up 4K of the file and tuck it into the RAM cache in hopes that the next read will be a cache hit—a request that will be filled from the RAM cache. The larger the RAM cache you give the server to use, the more data it can store and the better the system will perform. The difference in performance achieved by doubling the available cache, for example, could be as high as 20 or 30 to 1.

Let's look at the math: Suppose your server takes 20 milliseconds (ms) to process a request if it involves a disk access and 0.1 ms if it does not. Say that 60 percent of the requests can be filled with data available in RAM: a 60 percent hit rate. Then your server can process 100 requests in 806 ms. If by increasing the amount of cache, 99 percent of request could be found in cache, 100 requests could be processed in 29.9 ms: a 2,596 percent performance improvement.

Is this realistic? It is possible. Even a more modest improvement—from an 85 percent hit rate to 98 percent—would improve performance by about 600 percent. The hit rates you will see with different cache sizes depend on your usage patterns, but it is quite possible to achieve a very high hit rate for many applications.

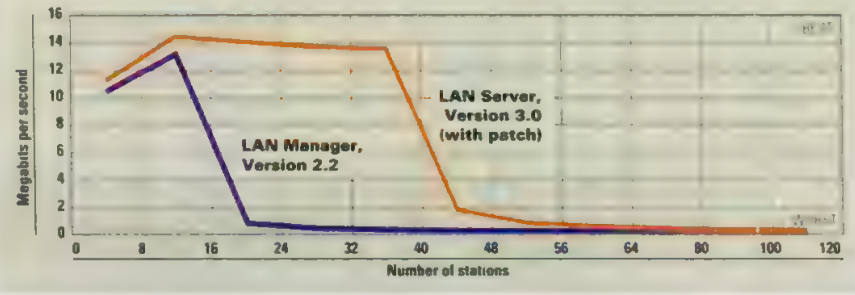
Analyzing Server Performance Graphs

This diagram demonstrates how the various portions of the server interact and contribute to overall network performance. These throughput curves are the result of testing with ZD Labs' benchmark test suite NetBench 2.06 on LAN Manager and LAN Server networks. Different parts of the throughput curves measure different bottlenecks.

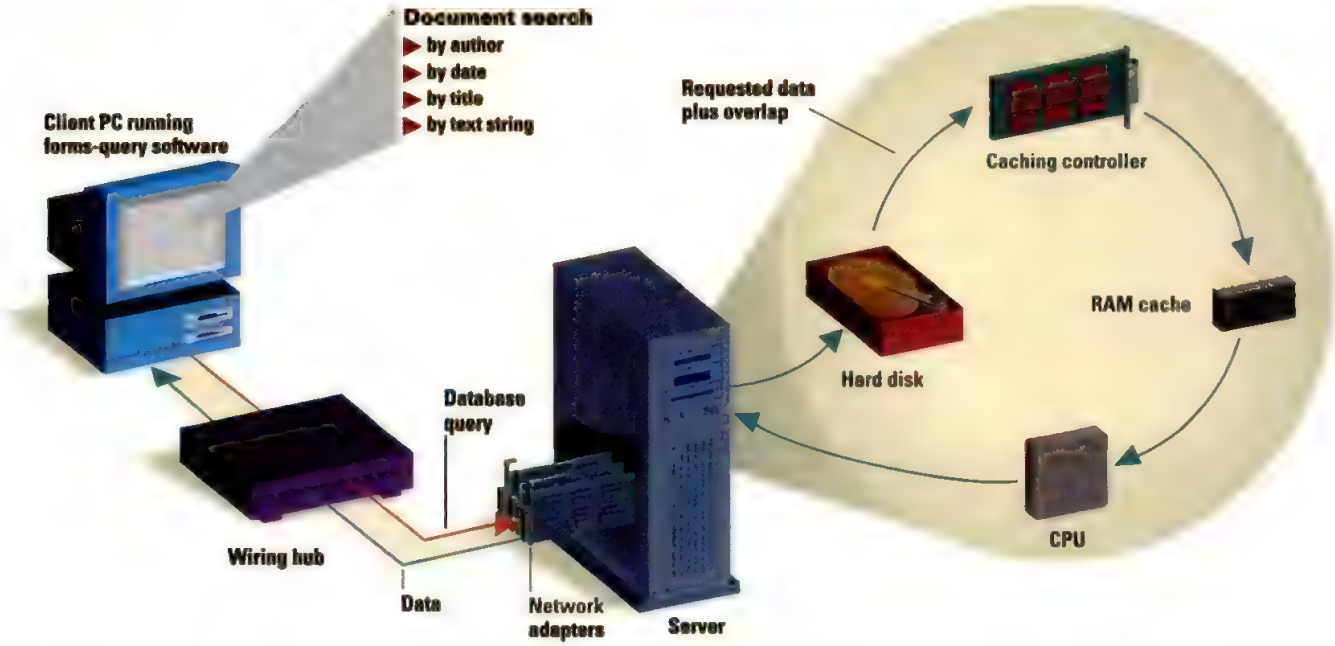
The peak of the curve represents maximum throughput. Your system should operate in this region when possible. Bottlenecks in this phase of testing are either in the CPU or the adapter.

The width of the peak represents sustainability—how heavy a load the system can handle without running out of cache. If you increase the cache of your system, you will obtain radically increased performance.

The tail of the curve is equivalent to the disk subsystem performance, since that is typically the bottleneck when there are many stations on the server. You can see that this portion of the curve is an order of magnitude lower than the peak region.



The Elements of Server Performance



Optimizing a server to process a database query efficiently begins with adding multiple network adapters to the server and increasing the amount of cache—the RAM used to store additional data read from the disk. These procedures remove the two key bottlenecks that typically limit server performance.

We think you should plan to have a minimum of 16MB of RAM in a heavily used server, and 32MB is a good buy if you are using an EISA or Micro Channel architecture (MCA) machine. Many ISA computers cannot effectively use more than 16MB of memory.

Remember those formulas about how much RAM you need for a NetWare server? Novell's minimum recommendation is .23 * volume size/block size. More RAM is better; anyone who tells you that having more RAM will slow down your computer by forcing it to search more RAM is wrong. Think about it: Accessing RAM takes about 70 nanoseconds (ns). If the operating system finds the data it needs there, then it doesn't need to spend the 10 or 20 ms it takes to access the disk. Remember, 10 ms is 10 million ns! That is a very good gamble, even if it requires quite a few 70-ns accesses to search for your data.

THE CACHING CONTROLLER

Computer scientists have long debated which segment of the server should control the cache: the hardware or the operating system. The debate has now been joined by marketing directors as various companies scramble for your upgrade dollars.

Some companies argue that investing in a caching disk controller is a better choice than investing in more RAM. The caching disk controller is close to the disk, so the cached data doesn't have to go through the data bus and be handled by the processor as it goes to RAM. You can put as much as 64MB of memory onto caching controllers marketed by companies such as Mylex, so they can hold as much data as a practical RAM cache. So, it would seem, the caching controller should be more efficient and less disruptive than a large RAM cache.

Some companies argue that investing in a caching disk controller is a better choice than investing in more RAM.

Unfortunately, the answer, as in most good arguments, is "It depends." Almost every installation is different. If the data bus, processor, and networking software do not present a bottleneck to the delivery of data to the RAM cache, then a caching controller will not improve performance.

Indeed, you can run into a problem called double buffering. This occurs when data is sitting in two caches at once and literally thrashes between the caches. Double buffering is an inefficient use of resources.

If you have sufficient processing power on a fast data bus in the server, the caching controller probably won't make a difference in throughput. But if either factor already limits performance, then adding a caching controller can make a big difference.

Overall, the effectiveness of caching depends on how your networked applications work. If every application always asks for blocks of previously unused data, then a cache won't help performance. But if, as so often happens, the applications

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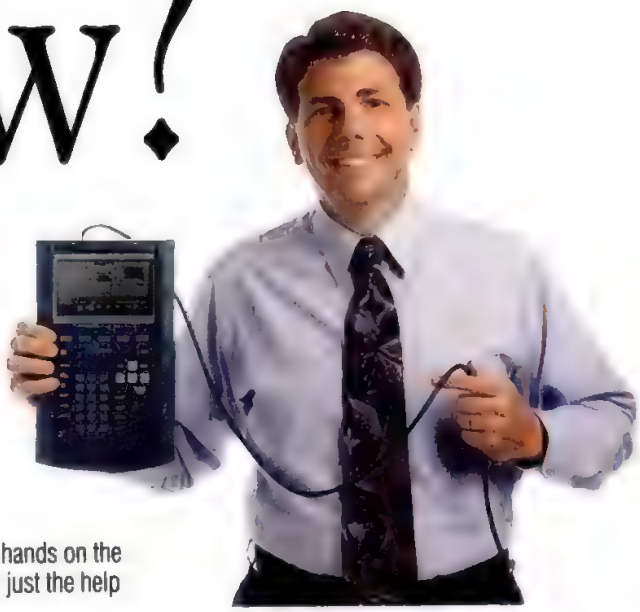

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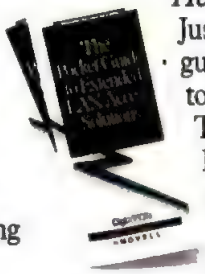

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ask for overlays, configuration files, and segments of data files, then a cache will make a tremendous difference in performance.

THE NETWORK FACTOR

Even with the best cache system, though, servers can be bottlenecked by other factors; most predominantly, the network interface. In addition, audio and video traffic threaten to swamp today's networks with data. High-speed networking technologies—those that can support speeds over 100 megabits per second (Mbps)—such as Fiber Distributed Data Interface, asynchronous transfer mode, and high-speed Ethernet, promise to overcome these challenges. But installing such networks takes time and money.

In the interim, you can open up the network bottleneck by segmenting the network and using Ethernet hub-switching technology (see "Networking: Speed to Burn," *PC Magazine: Network Edition,* June 29, 1993). You segment the network by installing several adapters in the file server, each giving a small clustered group of nodes network access through separate cables. This architecture reduces the contention on the cable because it means there are fewer nodes on the cable, and it is the easiest approach to better throughput. Hub switching accomplishes nearly the same thing by quickly switching Ethernet frames off of cable segments going to individual nodes or groups of nodes so that each node can access the entire 10-Mbps capacity of the cable.

Hub switching is both a less disruptive and a more flexible process than cable segmentation, but it is also more expensive.

REMOVING THE OTHER BOTTLENECKS

If your clients can get to the server without restriction, then what other hurdles do they have to cross to get to the data on the hard disk? Inside the server, there is a complex interrelationship of data handling that involves the adapters, the CPU, the software cache, and the hard disk itself.

The server is an interactive system. Certain resources of the system, particularly the CPU and data bus, restrict the activity of everything else. In turn, however, the CPU has constant demands placed on it by the other devices, such as network adapter cards that can steal away the data bus to transfer data. Internally, the file server is only as fast as its slowest element.

Is the server's CPU limiting the machine's performance? Under NetWare and Windows NT, checking the CPU utilization is easy. For optimal performance, you shouldn't run too far above 50 percent CPU utilization. If your CPU utilization runs over 60 or 70 percent, you need to upgrade your CPU or reduce the number of processes, such as network administration programs or virus checkers, running in the server.

Windows NT's Performance Monitor utility is great for removing server bottlenecks. The yellow line is cache, the red is processor utilization.

If you are going to budget a couple of thousand dollars to purchase a hard disk, today you should get the fastest 486/DX, not /DX2, processor available for the server. You want the DX processor because you want full 32-bit internal data pathways. Emerging chips such as the Pentium, PowerPC, and Alpha, for example, are also options for use as file server processors once they are proven in integrated systems.

When you select a network adapter for your heavily used server, you'll want a 32-bit bus-mastering device. Bus-mastering adapters transfer data to the PC without interrupting the CPU. If you use this criteria, you'll get adapters with plenty of on-board processing power that don't put an undue load on the server's CPU. There are differences in how specific makes and models of adapters interact with their network driver software, and those differences evolve with new releases of software (see "Ethernet Adapters: Fast and Efficient," *PC Magazine,* February 9, 1993).

The ISA bus simply isn't good enough for heavily used file servers. While bus mastering is possible in some ISA systems, you really need an EISA or MCA bus architecture so you can choose from a good selection of bus-mastering adapters and have the 32-bit bus to transfer data.

You wouldn't try moving a loaded filing cabinet with a little red wagon, and you shouldn't trust your gigabyte disk to DOS. Your heavily used server needs a network operating system that operates the processor in protected mode and moves data in 32-bit chunks. Banyan's VINES, Digital's PathWorks, IBM's OS/2, Microsoft's Windows NT, Novell's NetWare, Sun's Solaris, and a few other Unix-derived network operating systems meet this criteria.

In addition to their 32-bit architecture, these products also include important data-handling capabilities such as elevator seeking, directory hashing, and disk caching to help you get the data quickly and efficiently from your hard disk. Elevator seeking arranges read and write requests in a logical order for the heads on the hard disk. The elevator-seeking routines in the server's data-handling software queue requests to avoid large and time-consuming movement of the heads on the hard disk. Directory-hashing routines index directory entries according to a mathematical formula for fastest retrieval. The networking software creates indexes of the volumes and subdirectories so that it can get data from

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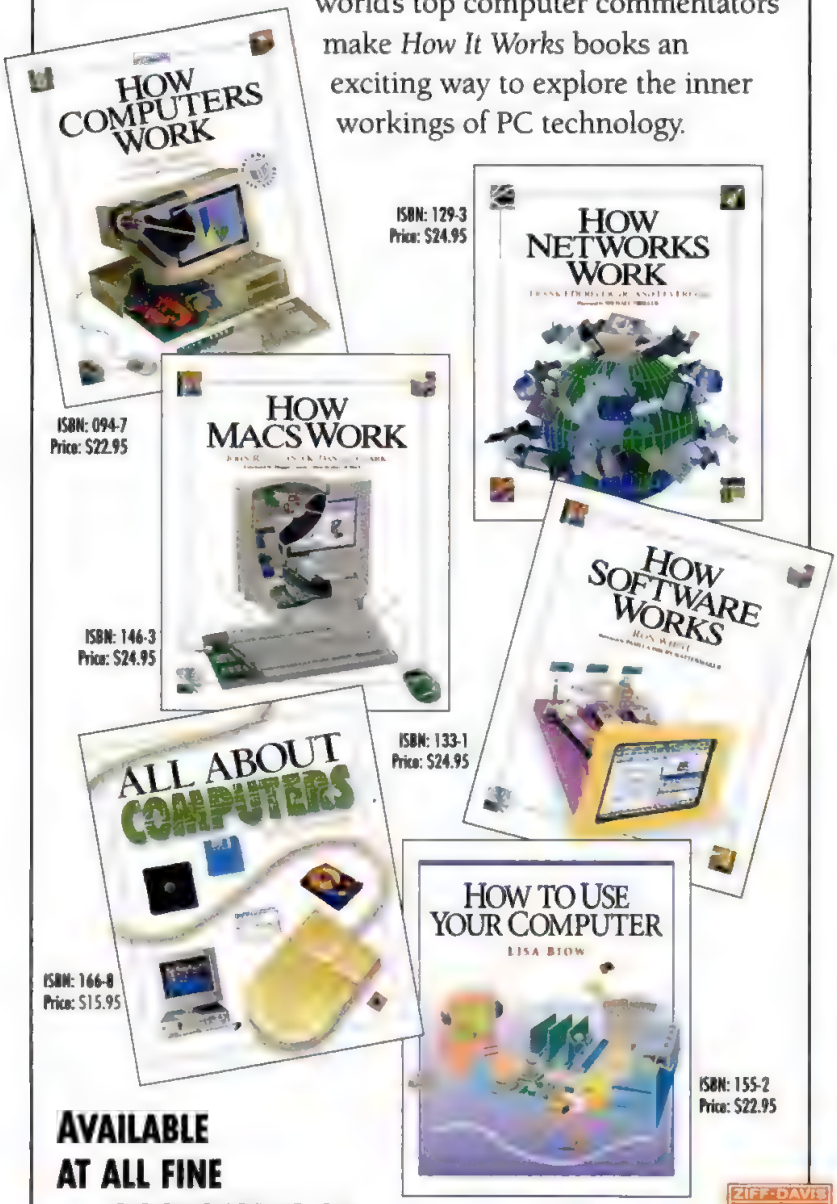

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the disk without doing additional reads. But the best insurance you can get for the investment you made in your big hard disk comes from the caching service of the network operating system.

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Redundant Array of Inexpensive Disks (RAID) technology is another effective way to improve disk performance. RAID Level 0, also referred to as striping, distributes files across multiple disks. This technique improves performance by ensuring an even load across your disks, and it's effective with as few as two hard disks. More sophisticated levels of RAID, such as Level 5, add parity information to make your system fault-tolerant. Unfortunately, they also carry a substantial performance overhead. One way to improve performance dramatically in a system that requires fault tolerance is to switch from a parity-based system to mirroring. Mirroring keeps a copy of your data on another hard disk; if something goes wrong with one, the other is available as a backup. As an added benefit, read accesses can be shared between the hard disks.

Networking is always a series of tradeoffs and complex interrelationships. When you spend a lot of money on one part of the system, you will get a good value for your investment only if you clear up bottlenecks in the other parts of the system. The hard disk is at the end of the chain between the clients and the server, so everything must be in balance in order for the hard disk to achieve its best performance.

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	Network Archivist 2.0	Cheyenne ARCserve	Maynard Maynstream	Emerald Express Librarian
Data Integrity Reliability	8.7	8.2	7.7	7.2
Automatic Backup	8.7	8.2	7.3	7.4
Security	7.7	7.6	6.6	6.2
Error-Handling	7.5	7.1	6.7	5.9
Complete Restore Time	7.1	7.1	5.9	5.2
Vendor Service	6.8	6.3	6.6	6.2

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FIRST LOOKS

HANDS-ON EVALUATIONS OF THE NEWEST NETWORK PRODUCTS

▶ STORAGE MANAGEMENT

Palindrome's Network Archivist Now Offers HSM

BY STEVE RIGNEY

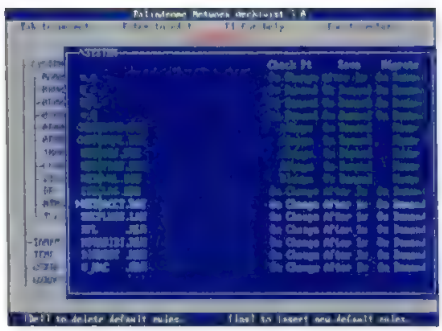
With Network Archivist, Version 3.0, Palindrome becomes the first vendor to give managers of NetWare networks the power to save money on backup media. The key is hierarchical storage management (HSM), a mainframe specification designed to use slower, less expensive media to store less-active files. While some vendors such as Conner Peripherals already offer HSM, nobody combines HSM with intelligent storage management. The result is a powerful rules-based system that can move files based on a myriad of criteria.

Network Archivist is based on a NetWare Loadable Module (NLM) and a DOS-based utility for configuring your backup procedures. The NLM is small and easy to install, unlike Cheyenne's ARCserve, the leading LAN-backup system for NetWare LANs, which requires 4MB of server memory just to load the individual NLMs.

Unfortunately, Palindrome's DOS-based configuration program is not intuitive, and a novice network administrator could become confused even after reading the manuals. However, if you understand network backup procedures, you can navigate the menus to use the powerful program.

Network Archivist's HSM support does not offer several key features that are available in other HSM products, such as Conner's HSM package.

The Conner HSM product is based on a dedicated HSM file server that manages the data from NetWare file servers on your LAN or WAN. The Conner HSM server uses a three-tiered process to store and manage your important data on less expensive storage media. Once data is initially moved to the Conner HSM server, it is stored on a mirrored hard disk, then it is transported to a less expensive optical drive, and finally it is moved to tape. This hierarchy offers the fastest retrieval of your stored data based on the age of the data and how often it is accessed (see "Conner HSM Safeguards Your Data," *PC Magazine: Network Edition*, September 28, 1993).



LAYING DOWN THE LAW: Network Archivist includes a rules-based system for setting file-backup criteria.

Network Archivist's HSM solution does not include a dedicated HSM server or make use of hard disks as the first level in the hierarchical storage system. Neither does it support automatic retrieval of moved data: If you need to retrieve a file that has been moved using Network Archivist, you must manually select that file with Palindrome's file-management utility and copy it back to your hard disk. Palindrome will introduce an automatic demigration utility before the end of 1993.

While the HSM support and other new features contribute to Network Archivist's appeal, data protection and backup are the

Continues on page NE26

▶ WIRING HUBS

NetWorth's New TriSegment Is More Than Just Another Stackable Hub

BY JIM QUEEN

Flexibility is the key to NetWorth's Series 3000 TriSegment Stackable Hub. The latest wiring hub from NetWorth combines two hot technologies—Ethernet switches and stackable hubs—to create a flexible wiring solution. Throw in HubView, NetWorth's Windows-based Simple Network Management Protocol (SNMP) management system, and this hub becomes one that small to medium-size businesses should really look at.

The Series 3000 TriSegment Stackable Hub comes in two models: STM-24 and STMM-24. The STM-24 is an unmanageable 24-port hub. By adding a daughter-

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Palindrome

CONTINUED FROM NE25

best selling points of the product. Network Archivist uses an expert system to determine which files to back up, where and how to store them, and when to perform backup. Unlike other LAN backup systems, such as Cheyenne's ARCserve, Network Archivist tracks individual files, not tape directories.

Network Archivist divides network data into two fields; Saves and Checkpoints. Checkpoints are active files that change periodically, such as spreadsheets or databases. The program stores these files each time they change. Files that do not change, such as executables and help files, are considered stable or Saves. The network administrator can customize the criteria for a stable file; for example, the file must not have changed for six weeks. Stable files are stored on at least three different tapes or optical disks in a rotation schedule before Network Archivist will flag the data as being a Save. Then, since the file is fully protected, the software will skip the file during a daily backup.

PICK A TIME: The Archive Configuration utility schedules automatic network backups.

Network Archivist offers a complete management and scheduling utility for your tape library. You can design your own tape rotation method to prevent excessive data loss due to tape failure, or you can use the Grandfather/Father/Son (GFS) or Tower of Hanoi algorithms that are already provided for you. With GFS rotation, you use three sets of tapes divided by period of backup—the daily backup is done on the son, the monthly backup is done on the father, and the weekly backup is done on the grandfather. So on a 5-day work week you need six tapes—four sons for each day, one for weekly backup, and one for monthly backup.

With Tower of Hanoi rotation, when new tapes are introduced they are used for every other media rotation. So, for example, if you had five tapes you would rotate them each day: The first tape would then be used the first day of the first and sixth week, the second tape would be used the second day of the first and sixth weeks, the third tape would be used the third day of the first and sixth weeks, and so on.

Another useful feature of Network Archivist is its ability to set up rules for both volumes and individual files. The rules allow you to define when a file should be saved or moved for HSM storage. Network Archivist also includes a basic type of virus protection: It will warn you if an executable file changes in size. Unlike Cheyenne's ARCserve, Network Archivist does not include a utility to back up NetWare clients, but a workstation program is available from Palindrome for $695.

Palindrome's Network Archivist provides a stable solution to LAN data protection. The added features of HSM and increased device support are icing on the cake of a well-designed storage management program.

• List price: *Palindrome Network Archivist, Version 3.0, $1,695 for 2 gigabytes of storage; $695 for additional packages that double your storage capacity. Palindrome Corp., 600 East Diehl Rd., Naperville, IL 60563; 708-505-3300; fax, 708-505-7917.*

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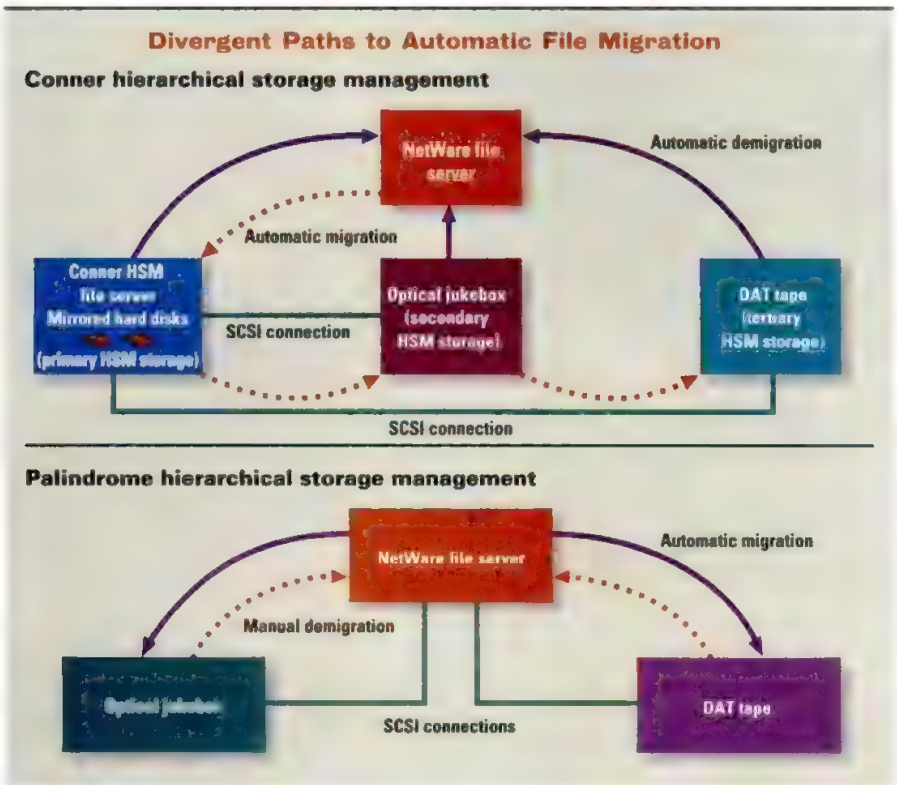

Conner Peripheral's hierarchical storage management (HSM) and Palindrome's HSM both provide automatic migration to various types of storage media. In addition, Conner provides automatic demigration and three levels of storage, but it requires a dedicated HSM file server to move the files.

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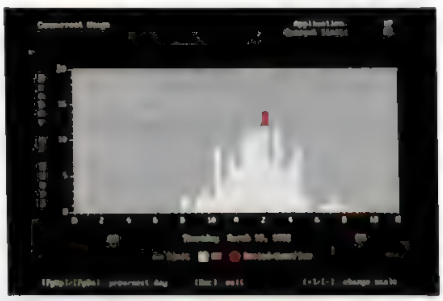

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NetWorth

CONTINUED FROM NE25

board, you can make it manageable (also sold under the name of STMM-24). Each hub provides either 23 or 24 shielded twisted-pair ports, depending on whether an optional media-expansion port is installed in the hub. The expansion port can be used to connect two Ethernet segments in separate hubs via attachment unit interface (AUI), BNC, or fiber-optic connectors.

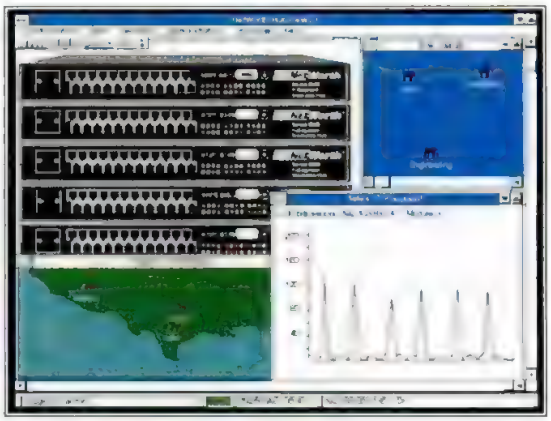
Part of the attraction of stackable hubs is that they allow you to start small and then add ports gradually as you need them. The Series 3000 is no different. You can stack five TriSegment hubs together for a total of 120 ports spread across 15 Ethernet segments. A push-button control panel on the front of each hub can be used to assign segments, but the management software provides easier configuration than does the push-button control panel. The management software also provides performance monitoring and the ability to lock the control panel. Hubs are connected to each other by way of a special bus extension cable.

The Series 3000's real value lies in its switching functionality: Individual ports—or, in the case of the Series 3000, groups of ports—can be moved to different networks with software. Network managers can then move users and change the network configuration without having to run to the wiring closet to make the change.

FLEXIBLE SOLUTION: The Series 3000 TriSegment Stackable Hub from NetWorth is segmentable.

In order to implement switching, one STMM-24 hub must be the top hub in a managed stack. There are eight ports per hub, configured into three groups. In a single hub, those groups can be connected to one of three segments. So with five hubs, for example, 120 ports can be connected to any of 15 segments. There is a caveat, though: No more than five segments can span the hubs. And these hubs must be together—the backplane bus extension cables are just long enough to connect to a stacked hub—and the bus extension design does not allow for longer cables to be used.

The groups can be added to each segment through the push-button control panel or managed either in-band (over the network) or out-of-band (via serial cable or modem connection) via HubView. Although the push-button panel took some getting used to, after a short while, figuring out which segment definitions were active and how to make changes became pretty easy.



WHAT A VIEW! HubView provides a port-status display, as well as network maps and performance charts.

After setting up a stack of hubs and then manually configuring the segments, we looked at the HubView software, which comes on two 3.5-inch disks and can be installed within a matter of minutes. HubView requires both the IPX and TCP/IP protocol stacks: IPX is used to discover managed hubs and to assign TCP/IP addresses, and TCP/IP is used to manage the hubs.

You control the Series 3000 through HubView by pointing and clicking on a graphical representation of an STMM-24 managed hub stack, although this image isn't always completely accurate. Even if the actual STMM-24 is at the bottom of the stack, HubView will show the management hub properly placed on top of the stack. We found that many problems associated with setting up switching on the Series 3000 can be traced to the fact that the STMM-24 was not placed on the top of the hub, but this placement problem was not indicated by the graphical representation.

After loading HubView and entering the Ethernet address of the management hub, we were able to poll the hub and automatically discover the configuration of the stack and the segment definitions.

HubView includes a complete set of SNMP management information bases (MIBs), which specify how to format the management data returned by the TriSegment hub. The MIBs are developed for the entire line of NetWorth managed hubs. The software can generate usage and performance graphs by port or segment and track SNMP alerts. Segment changes can be performed simply by clicking on a segment and assigning it to a segment number. The changes are immediate, however: It is not possible to build a configuration for activation at a later time.

NetWorth's TriSegment hubs, when combined with the management hardware and software, provide the LAN manager with a powerful set of tools for building a high-performance small to medium-size network. Even without the management modules, though, the hub's LEDs can be used to help determine the need to segment your LAN, and the control panel, although somewhat confusing, can be used to build the segments. Overall, this hub gets our nod for strong functionality in an affordable price range.

• List price: *Series 3000 TriSegment Stackable Hub STMM-24, $2,995; Series 3000 TriSegment Stackable Hub STM-24, $1,995; STM-24 to STMM-24 upgrade, $1,295; HubView software, $1,495; AUI connection, $250; BNC connection, $275; fiber-optic connection, $325. Each additional hub in a chain requires the $99 bus extension cable. NetWorth Inc., 8404 Esters Blvd., Irving, TX 75063; 800-554-4455, 214-929-1700; fax, 214-929-1720.*

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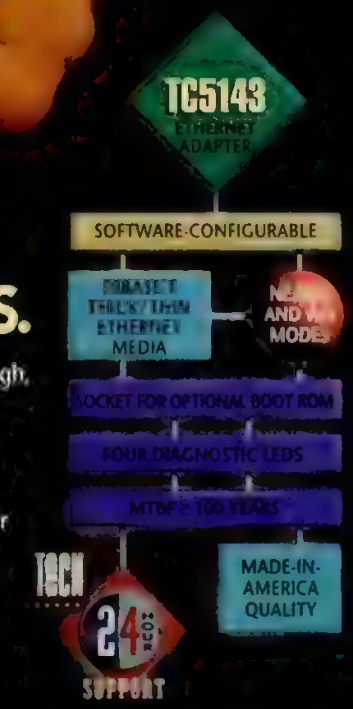

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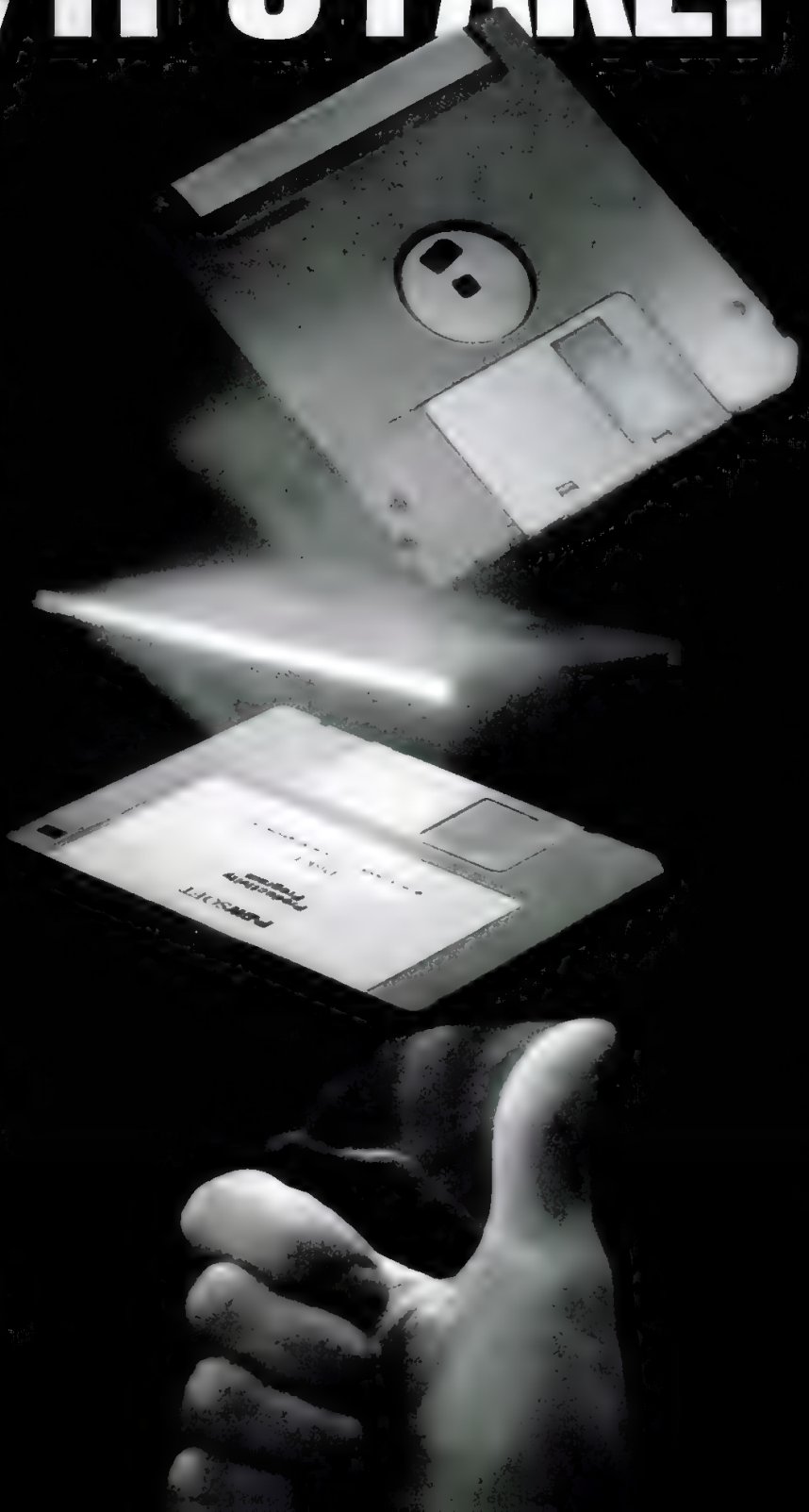

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CIRCLE 928 ON READER SERVICE CARD

▶HUBS

Alantec Introduces a Flexible High-Speed Network Switch

BY ROBERT P. LIPSCHUTZ

Some network administrators have a hard time trying to figure out exactly what it is that Alantec's new PowerHub 5000 does. Well, the PowerHub 5000 not only offers 68 ports for Ethernet hub-like connectivity, but it also offers the additional features of Ethernet switching, optional Fiber Distributed Data Interface (FDDI) support, translational bridging, and routing to maximize network bandwidth. So, in short, it pays to learn about what Alantec is doing.

Alantec's is the most flexible solution we have seen to date for local Ethernet and FDDI connectivity. Alantec segments the PowerHub 5000's 68 Ethernet ports into twelve 10-megabit-per-second (Mbps) segments and provides Ethernet switching between these segments. Two additional slots hold optional 100-Mbps FDDI boards for server connections and other types of connections that require high bandwidth.

Having two FDDI ports is advantageous because it allows high-speed servers to be accessed on one FDDI ring without interfering with traffic going to the campus backbone on the other ring. Like switches from Kalpana, Artel, and Synernetics, the PowerHub 5000 increases network bandwidth by segmenting network traffic and decreasing contention for bandwidth. The PowerHub 5000 also supports protocol-independent translational bridging, which allows the dissimilar Ethernet and FDDI topologies to be bridged together.

The PowerHub 5000's routing functionality includes support for the Internet Protocol (IP), the Internet Packet Exchange (IPX), and DECnet Phase IV protocols across both Ethernet and FDDI. Routing provides firewall protection, in which broadcast packets are confined to appropriate network segments. It also provides administrative flexibility, in which network addresses can be assigned logically to segments.

JACK-OF-ALL-TRADES: Alantec's PowerHub 5000 switch offers switching, routing, and FDDI support, in addition to its 68 ports.

Alantec makes no claim to solve all routing needs (it does not, for example, support WAN or Token-Ring interfaces), and some basic routing necessities are missing: The PowerHub 5000's IPX routing, for example, must mature, as no IPX Service Advertising Protocol (SAP) or network address filtering is currently available. Not having these features could cause problems when routing IPX.

Furthermore, although the IP routing is fairly complete, Open Shortest Path First (OSPF)—the IP routing protocol of choice in large networks—is not supported. The next release of software, Version 2.4, should address some of these problems by adding IPX SAP filtering and AppleTalk routing support.

Whether operating in a switching, translational bridging, or routing mode, the PowerHub 5000 performs admirably. According to recent tests conducted at Harvard University by Scott Bradner, the PowerHub 5000 bridged 92 percent of the six streams of 64-byte Ethernet traffic and fell off to only 77 percent and 84 percent, respectively, when routing IP and IPX. The PowerHub 5000 can bridge or route nearly 100 percent of 128-byte and larger packets. These numbers guarantee that the PowerHub 5000 will not create a bottleneck in any of your network communications. Performance when bridging or routing between Ethernet segments via FDDI was respectable at 70 percent.

Despite the PowerHub 5000's excellent performance, its management interface needs work. A cryptic command line interface burdens the configuration process. Besides the console interface, the PowerHub supports a slew of Simple Network Management Protocol (SNMP) management information base (MIB) objects, including MIB II and private hub, bridge, and FDDI extensions that can be accessed by any SNMP management platform such as HP OpenView and SunNet Manager.

Although the existing SNMP support is good, if Alantec wants to score big in the management arena, it should add remote monitoring (RMON) support to the PowerHub 5000, a feature currently not offered by any of the other switch manufacturers.

The PowerHub 5000 delivers the performance and flexibility that is necessary to optimize network bandwidth. However, improved IPX routing and better management facilities would make a good product even better.

• List price: *Alantec PowerHub 5000, including IP routing, $27,950; FDDI module, $7,950; IPX and DECnet modules, $1,250 each. Alantec, 2380 Bering Dr., San Jose, CA 95131; 800-252-6832, 408-955-9000; fax, 408-955-9500.*

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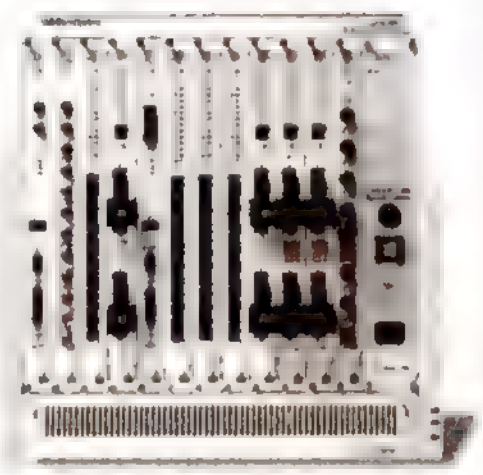

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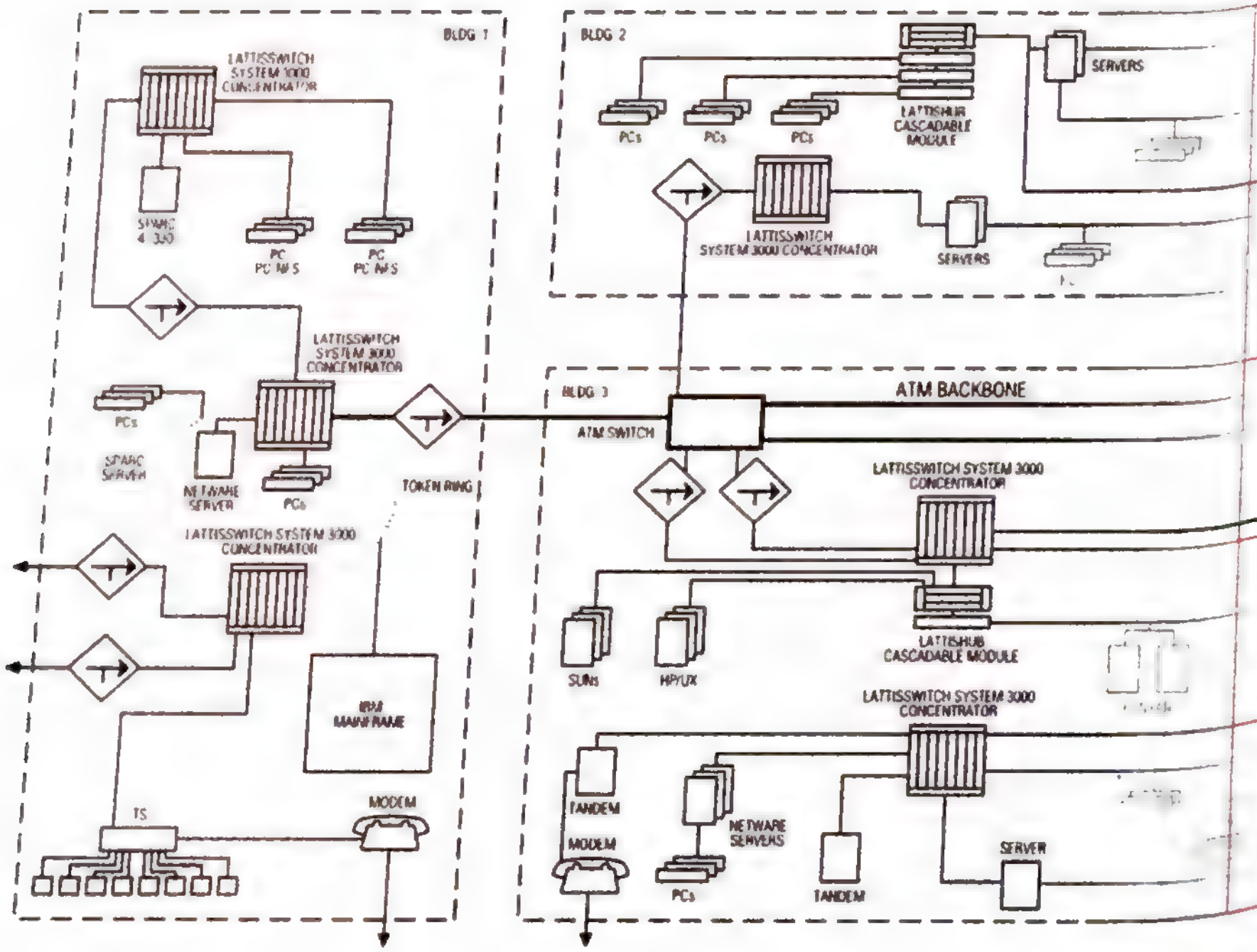

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over IP or IPX. All at a new lower price.

The System 3000 is flexible, too. It's expandable up to 264 ports and able to support complex internetworks covering large geographical areas. Presbyterian Healthcare System (PHS) of north Texas, for example, uses our hubs in a network that links four company locations, a dozen clinics and 5,000 employees.

Mel Lively, network manager for PHS, claims SynOptics helped him achieve almost 100% uptime. "I don't know anyone else who can match that record," declared Lively. "And that kind of reliability ends up saving significant time and money in the long run."

The System 3000 is a key building block of the network fabric—a managed, high-speed communications system that supports new classes of enterprise and multi-enterprise applications. As your business grows, the network fabric will expand and evolve with it.

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▶HUBS

3Com Offers Affordable FDDI Hub

BY JEFFREY D. BAHER

As vendors strive to take the "F" out of FDDI (Fiber Distributed Data Interface), a need for more flexible FDDI hubs has arisen. 3Com addresses this need with the introduction of the LinkBuilder FDDI Workgroup Hub: a low-cost, chassis-based FDDI hub that supports fiber, unshielded twisted-pair (UTP), and shielded twisted-pair (STP).

FIBER AND COPPER: The chassis-based LinkBuilder supports fiber and twisted-pair connections.

Especially with the advent of FDDI-over-UTP, which utilizes the less-expensive UTP medium instead of fiber, FDDI has become a more affordable high-speed networking solution. FDDI-over-UTP does not obviate FDDI-over-fiber, however, which remains a more viable medium for campus backbones. Thus, demand has increased for a hub that is both affordable and flexible in terms of media support.

In the past, affordability meant purchasing a fixed-port hub, but doing so ruled out the possibility of changing the network media. Chassis-based hubs allowed users to swap out modules and change the media, but they were expensive. The LinkBuilder FDDI represents a compromise, providing an affordable and flexible solution for FDDI workgroup environments.

The LinkBuilder FDDI hub has four slots. The chassis itself lists for $995, and the management module, which occupies the first slot, lists for $2,295. The three remaining slots can be populated with any combination of the following FDDI media modules: a four-port fiber module, an eight-port UTP module, and a six-port STP module.

Management is available through primitive console commands and management console commands. The primitive console commands, available only through the serial port, provide access to the hub in those rare instances when the user forgets the password to the management console, when a faulty image is downloaded into erasable programmable ROM and the hub needs to be reset, or when the hub has been configured with illegal commands and has become inoperable.

The management console commands—accessed either through a modem, a TELNET session, or the serial port—provide commands to display current parameter settings and configuration information, modify settings, and display a list of command descriptions. Most importantly, the management console commands allow the user to set the IP address of the hub as well as modify Station Management (SMT) parameters, including the Target Rotation Time, a variable that determines the speed of the FDDI token.

Support for the Simple Network Management Protocol (SNMP) is lacking, however, and this is perhaps the LinkBuilder FDDI's biggest limitation. SMT is the native management protocol for FDDI, and a proxy agent is typically implemented to convert SMT to SNMP for management purposes. At present, no proxy agent is available for the LinkBuilder Workgroup, although 3Com intends to introduce one by January 1994.

Despite the lack of SNMP support, the LinkBuilder FDDI Workgroup Hub remains an affordable solution, especially for those looking to implement FDDI over a variety of different media. The LinkBuilder's value should only increase when SNMP support becomes available.

• List price: *LinkBuilder FDDI Workgroup Hub chassis, $995; management module, $2,295; fiber module, $3,295; UTP module, $3,295; STP module, $2,195. 3Com Corp., 5400 Bayfront Plaza, P.O. Box 58145, Santa Clara, CA 95052-8145; 408-764-5000.*

Circle 964 on reader service card

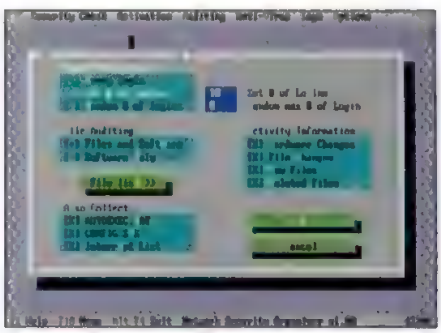
▶NETWORK SECURITY

Leprechaun Software's NSO Makes Network Virus Protection Easier

BY STEVE RIGNEY

An antivirus program can find and remove computer viruses on your network, but it may not offer a complete solution for preventing viruses from gaining access. Leprechaun Software's Network Security Organizer (NSO) works with antivirus software to help network administrators prevent the spread of viruses by monitoring the activity of client PCs and reporting on NetWare access rights.

NSO, Version 1.0, is a DOS-based program for use with NetWare 3.11 LANs. A five-user license retails for $250 and includes Leprechaun's Virus Buster antivirus software. While NSO works closely with Virus Buster, you can also use other network antivirus soft-



SECURITY SETUP: NSO provides a variety of configuration options for auditing your LAN.

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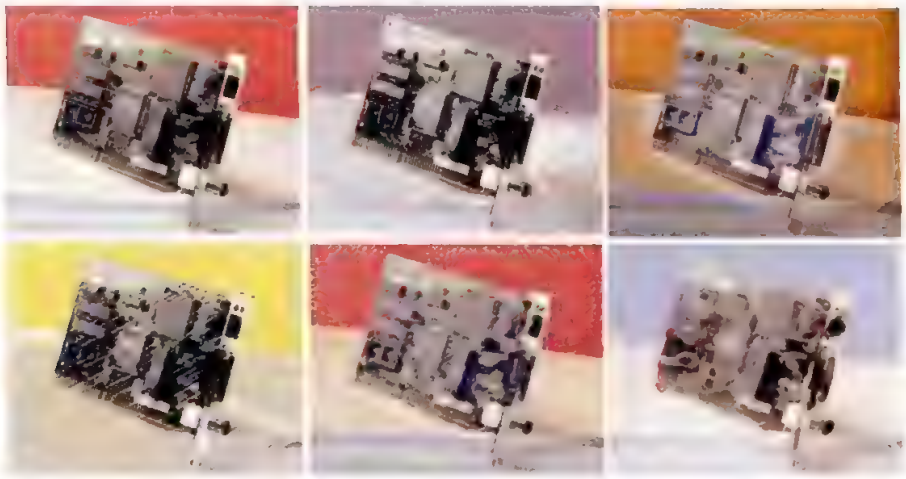

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Leprechaun

CONTINUED FROM NE38

ware, such as Central Point Anti-Virus for DOS and Windows or Dr. Solomon's Anti-Virus Toolkit.

Virus Buster includes both a virus scanner and a checksummer. A virus checksum utility is important for detecting polymorphic viruses, which change and mutate frequently. The program detects computer viruses using either a DOS-based virus detection program or a 10K TSR called VBTSR.

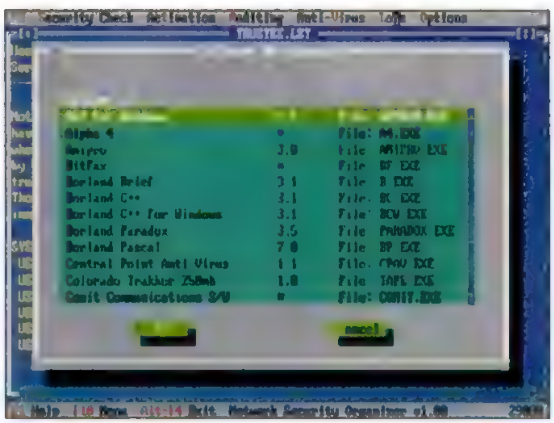
Working in conjunction with antivirus software, NSO is not itself a virus scanner or checksum program. It is, in fact, a comprehensive management tool designed to help you analyze your network's vulnerability to viruses, report on any virus attacks on the network, install or update many virus programs, and provide management for your client PC's hardware and software.

The most useful feature of Network Security Organizer is its ability to check the NetWare security rights of individual users on the network quickly. For example, you can use the NSO program to list all NetWare users who have supervisory privileges and to see which users have access to which files and directories. Performing this type of security analysis on a medium-size to large network could take hours using the NetWare Syscon utility.

Once the NSO program tells you who has rights to which areas, you can use this information to protect your network from the corruption and spread of computer viruses. Since network viruses can only corrupt executable files, you can use NetWare to eliminate certain individuals' rights to modify executable files while retaining their rights to modify data files, so you can prevent a virus from gaining access to your network. It should be noted that this technique is far from ironclad; someone can still log on with a borrowed identity. For this reason, you should also use a virus scanner or checksum program on your network.

Using a 10K TSR on each client PC, NSO can also gather basic hardware and software inventory information from each client. Currently, NSO recognizes approximately 50 major software packages and their version numbers.

The hardware inventory function includes CPU type, memory size, and hard disk size. The NSO inventory utility does not offer the rich reports and statistics available from other LAN inventory programs such as BindView from The LAN Support Group, but it will help you monitor basic information and also prevent gross hardware and software theft.



PLENTY OF CHOICES: Most major applications are recognized by Network Security Organizer's software inventory feature.

The proliferation and mutation of computer viruses drives a constant flow of updates to commercial antivirus programs. NSO allows you to automatically check and update the antivirus software on every client PC on the network. For example, if you currently use the MS-DOS 6.0 antivirus utility and receive an update, NSO can automatically copy that update to every PC on the LAN. If the antivirus software package you currently use doesn't offer frequent updates, it's time to think about changing your software.

Leprechaun offers monthly updates for the Virus Buster program. The next release of Virus Buster will also include a program that will automatically call the Leprechaun BBS, download the latest virus update, and install it in the correct location. NSO users will be able to use this utility to update every PC on their network.

Leprechaun's Network Security Organizer is a good tool for keeping a sharp eye on your LAN's security. NSO combines the advantages of your antivirus software, NetWare's security features, and basic LAN inventory functions to provide the basis for keeping your LAN secure and virus-free.

• List price: *Network Security Organizer, Version 1.0, $250. Leprechaun Software International Ltd., P.O. Box 669306, Marietta, GA 30066-0106; 404-971-8900; fax, 404-971-8828.*

Circle 966 on reader service card

Driver Alert

The following table lists recently released software drivers and utilities from Gateway Communications, Microsoft, and Novell. This software can be obtained from Library 9 (SOS Driver Alert) of the Utilities/Tips Forum on ZiffNet. A complete source of network technical support information including technical articles, documentation, and supplemental software from leading manufacturers and software publishers can be found on Support On Site, the monthly CD-ROM published by Computer Library. For information call 212-503-4400.

Filename	Size (kilobytes)	Release date	Description
CPAVGA.EXE	32	20-Aug-93	Compaq AVGA display driver for Windows NT
IBM4MM.EXE	70	20-Aug-93	IBM 2.0GB 4-mm tape-drive driver (Intel) for Windows NT
MKECR.EXE	40	20-Aug-93	Panasonic CR-52x and CR-56x CD-ROM driver for Windows NT
S31AM.EXE	50	20-Aug-93	MIPS storage driver for the Sony 31A drive for Windows NT
S31X86.EXE	42	20-Aug-93	X86 storage driver for the Sony 31A drive for Windows NT
T348.EXE	31	20-Aug-93	Trantor T348 MiniSCSI Plus driver (Intel).
PTF388.EXE	292	16-Jul-93	Patch for 3270 LAN Workstation for Windows
CHK375.EXE	29	18-Aug-93	CHKDIR.EXE, Version 3.75.
ATOK31.EXE	20	13-Aug-93	ATTOKLLC.NLM, Version 3.1. Lets Macs in NetWare with non-IBM Token-Ring cards communicate in a source-routing environment

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FDDI ADAPTERS

Madge Jumps on the FDDI Bandwagon

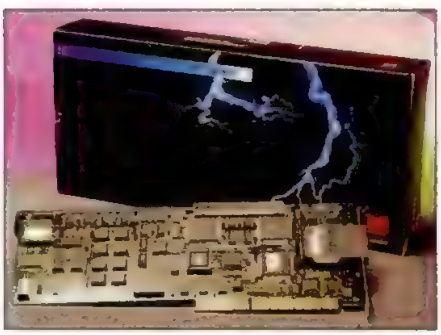
BY JEFFREY D. BAHER

The race is on in the high-speed networking arena, and Madge Networks has announced its entry: the Smart 100 EISA Ringnode, Madge's first 100-megabit-per-second (Mbps) Fiber Distributed Data Interface (FDDI) adapter. Recognized as the market leader in Token-Ring adapters, Madge now offers FDDI adapters for both fiber and shielded twisted-pair (STP), with adapters for unshielded twisted-pair scheduled to follow.

Soon, consumers will be overwhelmed by a deluge of high-speed networking technologies including 100BaseVG, Fast Ethernet (100BaseX), and asynchronous transfer mode (ATM). But FDDI still has many advantages. FDDI is a proven technology that has been around since the late 1980s and is widely available. FDDI also supports cabling distances of up to 2 kilometers, in contrast to the 100 meters supported by 100BaseVG and Fast Ethernet. And FDDI's dual-ring capability is invaluable from a fault-tolerant standpoint. Madge, like other vendors such as 3Com and Network Peripherals, recognizes FDDI's strengths as a high-speed networking solution and looks to gain market share with what it refers to as its Fast Token-Ring product line.

The new line's name accurately describes FDDI (a token-passing network) and helps to leverage Madge's proven success in Token-Ring. Despite the proprietary nomenclature, these adapters are fully compliant with the ANSI X3T9.5 FDDI standard. Moreover, while Madge would like to leverage its past success, the bottom line is that it will have to prove itself in the competitive FDDI market. And Madge still has some proving to do.

Madge's FDDI adapters are competitively priced. The single-attached FDDI-over-fiber adapter is $100 cheaper than 3Com's comparable FDDILink Model 3C771 fiber adapter and $200 cheaper than Network Peripherals' NP-EIS-S10.



FORGING AHEAD: The Madge Smart 100 EISA Ringnode is Madge's first FDDI adapter.

But while price favors Madge, performance does not.

Our tests show 3Com's bus-mastering Model 3C771 to be more efficient as a server adapter than Madge's Smart 100 Ringnode, which is not a bus-mastering card. The Madge reported considerably higher CPU utilization figures. During ZD Labs' NetBench 2.06 NIC Throughput test, the 3Com never utilized more than 62 percent of the server's CPU, while the Madge never used less than 69 percent. So although the Madge matched the 3Com in performance (and, in fact, outperformed it on the 4K block size), the Madge's high CPU utilization makes it a poor candidate for CPU-intensive server environments or multi-segment server environments, where multiple adapters are required.

The Madge rebounded during the workstation test, outperforming the 3Com in all block sizes. The Madge was particularly impressive with the largest block size (4K), where it outperformed the 3Com by 205 percent.

While Madge's Smart 100 EISA Ringnode FDDI adapter is competitively priced, the less-than-stellar server performance makes it difficult to justify any monetary savings. In particular, if you are considering an FDDI adapter for an application or print server where CPU cycles are precious, the Madge Smart 100 EISA Ringnode is not the best choice. On the other hand, if it's an

Continues on page NE46

NETWORK MANAGEMENT

LinkWatch Token-Ring Provides Inexpensive Management Alternative

BY ROBERT P. LIPSCHUTZ

If your Token-Ring network is running circles around you, consider 3Com's low-cost management solution, LinkWatch Token-Ring. Until now, expensive managed hubs and high-end management software were the only ways to isolate one of the most common problems of Token-Ring networks: runaway beaconing adapters. If you have passive (nonmanaged) hubs in your wiring closet and no management software on your desktop, you probably know the pain of a malfunctioning, out-of-control Token-Ring network.

3Com's new management solution is an affordable package that manages 3Com and IBM cards. Better still, LinkWatch can manage the network through a proprietary protocol and through the most common management protocol, the Simple Network Management Protocol (SNMP). Unfortunately, LinkWatch Token-Ring does not manage Novell server cards, leaving your server—your most important computer—unmanaged.

Expensive managed hubs such as those from IBM, Cabletron, and SynOptics use intelligence at the hub. But these solutions often sell for more than $5,000, as opposed to the LinkWatch's $395.

Both the expensive hub management products and LinkWatch monitor four important areas: statistics tracking, bea-

Continues on page NE46

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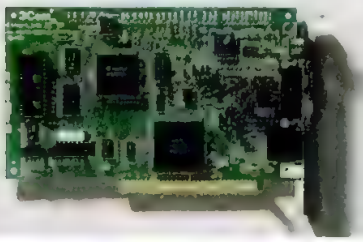
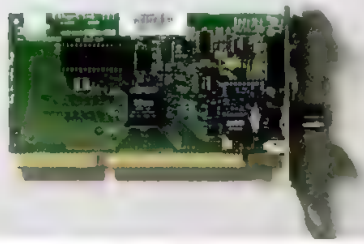
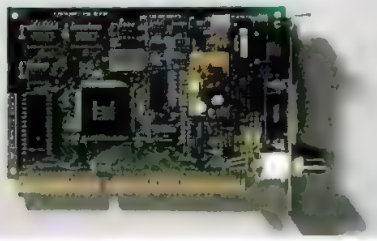


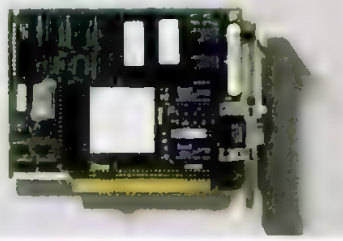
3 COM ETHERLINK III 3C509 COAX



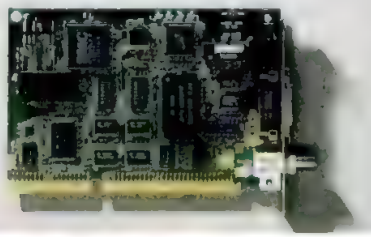
ACCTON ETHERNET COMBO



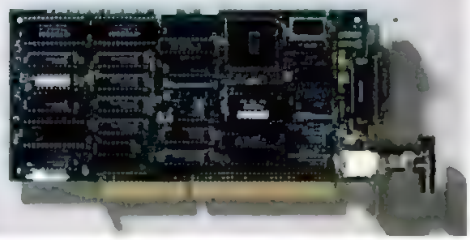
IBM 16/4 TOKEN RING



SMC ETHERCARD PLUS ELITE 16 COMBO



EAGLE NE2000 PLUS 3-ETHERNET



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Madge

CONTINUED FROM NE44

FDDI workstation you're looking to outfit, the Madge will provide both solid performance and price.

• List price: *Madge Smart 100 EISA Ringnode, single-attached fiber adapter, $1,795; dual-attached fiber adapter, $2,695; single-attached STP adapter, $1,395; dual-attached STP adapter, $1,995. Madge Networks Inc., 2310 North First St., San Jose, CA 95131-1011; 800-876-2343; fax, 408-955-0970.*

Circle 965 on reader service card

Benchmark Test: FDDI Adapters

Overall, the 3Com FDDILink Model 3C771 EISA was the better server adapter we reviewed. It performed nearly the same as or slightly better than the Madge Smart 100 EISA Ringnode but was considerably more efficient. However, as a workstation adapter, where efficiency is not nearly as important, the EISA Ringnode proved to be considerably better

The server test environment consisted of one Compaq Systempro/XL50 server and four Compaq Deskpro 486/33M workstations. The workstation test environment consisted of one Systempro/XL50 server and one Deskpro 486/33M workstation

The **NIC Throughput** test from NetBench 2 06 evaluates the amount of data that an adapter can transfer across the network in 1 second. A PC equipped with the adapter issues a series of read requests to a file stored in the server's cache.

The **Performance Index** is the ratio of bandwidth utilization to CPU utilization as measured by Novell's STAT NLM

NIC THROUGHPUT (SERVER)

Megabits per second

Block size ▶	64 bytes	512 bytes	1K	4K
Madge Smart 100 EISA Ringnode	4.40	28 70	50 80	82 70
3Com FDDILink Model 3C771 EISA	4 80	29 40	50 90	75.30

Higher scores represent better performance

PERFORMANCE INDEX

Block size ▶	64 bytes	512 bytes	1K	4K
Madge Smart 100 EISA Ringnode	0.06	0.33	0 55	1 18
3Com FDDILink Model 3C771 EISA	0.08	0.55	1.17	3 00

Higher scores represent better performance

CPU UTILIZATION

Percent

Block size ▶	64 bytes	512 bytes	1K	4K
Madge Smart 100 EISA Ringnode	78 80	86 70	92 90	69 80
3Com FDDILink Model 3C771 EISA	62 60	53 50	43 40	25 10

Lower scores represent better performance

NIC THROUGHPUT (WORKSTATION)

Megabits per second

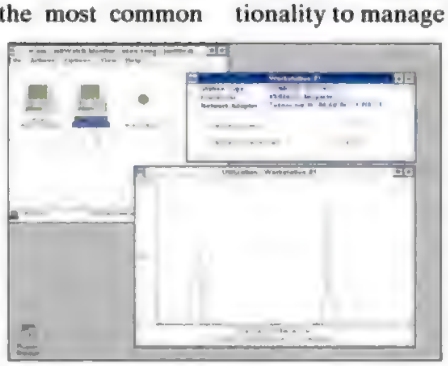
Block size ▶	64 bytes	512 bytes	1K	4K
Madge Smart 100 EISA Ringnode	1 30	8 50	16 30	48 50
3Com FDDILink Model 3C771 EISA	1.20	7 30	12 70	23 60

Higher scores represent better performance

LinkWatch

CONTINUED FROM NE44

coning isolation, remote disabling, and ring mapping. LinkWatch also lets you monitor various traffic and error statistics. When a beaconing adapter—the most common Token-Ring error—is detected, it can be viewed and either isolated from the ring or remotely disconnected from the network from the management console. Some Token-Ring errors can be isolated by looking at the order of stations that the token passes as it travels around the ring, and for this reason LinkWatch provides ring mapping.



VITAL SIGNS: Clicking on a workstation icon reveals the network statistics of that PC.

LinkWatch comprises three components: driver agents that reside on and gather information about Token-Ring connected PCs, a Windows-based application to monitor the proprietary packets provided by the driver agents, and an SNMP proxy agent that converts 3Com's proprietary agent protocol to standard SNMP packets.

LinkWatch provides the basic functionality to manage beaconing adapters, although managed hubs are smarter in dealing with Token-Ring errors: A managed hub will isolate a problem node after an error threshold is reached, while LinkWatch may just turn an icon red and wait for you to handle the problem.

LinkWatch provides a graphical ring view with the necessary traffic and error statistics to solve a problem. LinkWatch also provides some basic workstation inventory information including CPU, memory, and user-defined information.

If you plan to use SNMP-based management soon, the SoftHub/DOS component of LinkWatch will interest you. This software resides on a dedicated DOS workstation and translates 3Com's proprietary protocol to the standard SNMP protocol, thereby giving SNMP management stations the ability to manage the network. SNMP has traditionally only been important in the Ethernet world, but with IBM entering the market with NetView/6000, SNMP will likely become prevalent in the Token-Ring community.

Despite some annoyances in NetWare environments, such as the lack of support for NetWare servers, LinkWatch serves its purpose as a low-cost functional tool for Token-Ring management. If you are on a tight budget, this product is certainly worth the money. You will no longer be making excuses for poor Token-Ring performance.

• List price: *LinkWatch Token-Ring, $395. 3Com Corp., 5400 Bayfront Plaza, P.O. Box 58145, Santa Clara, CA 95052-8145; 408-764-5000.*

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▶TOKEN-RING ADAPTERS

IBM Releases Its First EISA Token-Ring Adapter

BY JEFFREY D. BAHER

Token-Ring giant IBM has unveiled its first Extended Industry Standard Architecture (EISA) Token-Ring LAN adapter: the 16/4 Busmaster EISA Adapter. Priced at $720, the 16/4 Busmaster EISA Adapter brings competitive pricing and respectable performance to the EISA market, a market that IBM has avoided for years.

In the late 1980s, IBM introduced its proprietary 32-bit Micro Channel Architecture (MCA) bus architecture with its PS/2 line of computers. As a registered trademark of IBM, the Micro Channel bus architecture and its associated licensing fees proved costly for non-IBM manufacturers looking to implement a high-performance 32-bit bus architecture. The industry reacted with the EISA standard, a 32-bit bus architecture delivering comparable performance without IBM's steep fees. In light of this history and IBM's long-standing allegiance to the Micro Channel standard, the 16/4 Busmaster EISA Adapter comes as a surprise to many.

Naturally, IBM's success in the EISA market will depend largely on performance. When tested against the market leader, Madge Networks' Smart 16/4 EISA Ringnode ($995), the 16/4 Busmaster EISA Adapter showed room for improvement. On the server adapter test (see benchmark test results), ZD Labs' NetBench 2.06 NIC Throughput test, results favored Madge's product.

Madge's adapter also delivered lower CPU-utilization figures, making it a more likely candidate for a CPU-intensive server environment or a multisegment server environment, where multiple adapters are required. The difference in CPU utilization can be attributed primarily to the proprietary bus-mastering controller chip that IBM implements. Madge, on the other hand, uses the Intel 82355 bus-mastering controller chip, a proven performer in the industry.

While there were clear performance differences on the server adapter test, the gap between IBM and Madge closed up on the workstation test. IBM proved slightly faster with the smaller block sizes (64-, 128-, 256-byte), while Madge remained a clear winner with the 512-byte, 2K, and 4K block sizes.

The Busmaster supports both 16-megabit-per-second (Mbps) and 4-Mbps ring speeds as well as both unshielded twisted-pair and shielded twisted-pair cabling schemes. Additionally, IBM includes both Network Driver Interface Specification (NDIS) and Open Datalink Interface (ODI) drivers for DOS and OS/2.

The IBM 16/4 Busmaster EISA Adapter by no means sets new standards for EISA Token-Ring performance, but it does represent a new direction for IBM. And as IBM's first EISA exploit, it deserves considerable praise. Especially if you are looking to outfit EISA workstations, the 16/4 Busmaster EISA Adapter is a solid choice that offers both competitive performance and price vis-a-vis the market leader, plus the IBM name to back it up. If you are looking for a server adapter, however, IBM's low price is not enough to justify a move away from Madge.

• List price: *IBM 16/4 Busmaster EISA Adapter, $720; IBM Corp., 1133 Westchester Ave., White Plains, NY 10604; 800-426-3333; fax, 800-426-2255.*

Circle 961 on reader service card

Benchmark Test: Token-Ring Adapters

Madge Network's Smart 16/4 EISA Ringnode is a faster and more efficient NetWare server adapter than the IBM 16/4 Busmaster. As a workstation adapter, though, the IBM adapter is faster with small block sizes

The **Performance Index** is the ratio of bandwidth utilization to CPU utilization as measured by Novell's STAT NLM

The **NIC Throughput** test from NetBench 2.06 evaluates the amount of data that an adapter can transfer across the network in 1 second. A PC equipped with the adapter issues read requests to a file stored in the server's cache

NIC THROUGHPUT (SERVER)

Megabits per second

Block size ▶	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K	4K
IBM 16/4 Busmaster EISA Adapter	1.12	2.19	4.10	6.58	9.78	14.29	15.39
Madge Smart 16/4 EISA Ringnode	1.36	2.60	5.04	7.80	11.20	14.48	15.38

Higher scores represent better performance

CPU UTILIZATION

Percent

Block size ▶	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K	4K
IBM 16/4 Busmaster EISA Adapter	45.40	42.90	40.90	35.40	27.30	20.90	12.90
Madge Smart 16/4 EISA Ringnode	31.10	30.80	31.10	25.20	20.00	14.10	8.90

Lower scores represent better performance

PERFORMANCE INDEX

Block size ▶	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K	4K
IBM 16/4 Busmaster EISA Adapter	0.15	0.32	0.63	1.16	2.24	4.27	7.46
Madge Smart 16/4 EISA Ringnode	0.27	0.53	1.01	1.93	3.50	6.42	10.80

Higher scores represent better performance

NIC THROUGHPUT (WORKSTATION)

Megabits per second

Block size ▶	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K	4K
IBM 16/4 Busmaster EISA Adapter	0.42	0.80	1.47	2.33	4.10	6.15	8.04
Madge Smart 16/4 EISA Ringnode	0.35	0.69	1.36	2.46	4.00	6.53	9.16

Higher scores represent better performance

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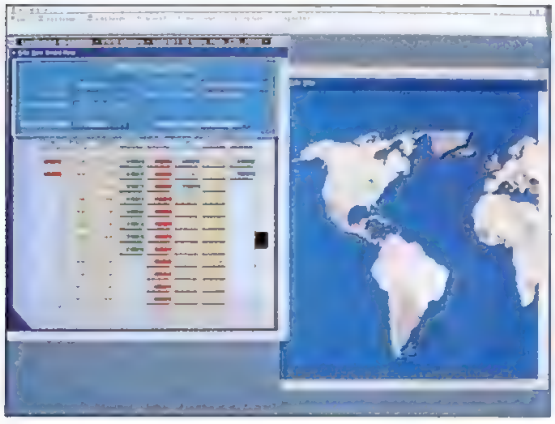
Cabletron Announces Multiplatform Management Solution

Cabletron Systems now offers one of the industry's first network management applications to operate across multiple management platforms. Spectrum for Open Systems provides network managers with a choice of management solutions for their Cabletron bridges, routers, adapters, and hubs, which can all be managed under HP OpenView Unix, IBM NetView 6000, SunNet Manager, or Novell NMS. Spectrum for Open Systems provides network managers with the freedom to choose a management solution that easily adapts to their environment, and it protects their investment in the installed network. The management application features support for the Remote Monitoring MIB and Cabletron's Distributed LAN Monitor.



FREEDOM: *Spectrum supports multiple platforms.*

Cabletron also announced Spectrum, Version 2.0, an enhanced management platform for porting applications between Unix platforms. This latest version operates across IBM's RISC System/6000; SGI Indigo; Sun Solaris; and DEC 2100, 3100, and 5000 Ultrix platforms. Spectrum, Version 2.0 features newly bundled applications, including Spectrum Data Export, Spectrum Report Generator, and Spectrum Command Line Interface.

• List price: *Spectrum for Open Systems, $3,995 (includes the platform adapter and two device management modules); additional modules, $1,495. Spectrum, Version 2.0, $15,000. Cabletron Systems Inc., 35 Industrial Way, Rochester, NH 03867-0505; 603-332-9400; fax, 603-337-2211.*

Circle 952 on reader service card

NEW

Cisco and Novell Enter Strategic Partnership

Cisco Systems makes a move toward greater network interoperability with its alliance with Novell. The partnership centers around integrating Cisco's internetwork routers with Novell's NetWare network products. The integration began with IPX support for Cisco routers. Additional elements of the partnership will include support for Novell's NetWare Link Services Protocol (NLSP) in Cisco routers and support for IPXWAN (IPX across wide area network media). NLSP, available in 1994, will provide seamless routing across NetWare and Unix environments. Cisco and Novell demonstrated their joint support for IPXWAN at Interop 93 in August.

• *Cisco Systems Inc., P.O. Box 3075, 1525 O'Brien Dr., Menlo Park, CA 94026; 800-326-1941, 415-326-1941. Novell Inc., 122 East 1700 South, Provo, UT 84606-6194; 800-453-1267, 801-429-7000; fax, 801-429-3944.*

Circle 968 on reader service card

HOT PROSPECT

Alantec's PowerHub Delivers Another First

Alantec's intelligent switching hub, PowerHub, is the first to provide support for multiple-participant multimedia applications. Network managers can now take advantage of bandwidth-hungry applications such as desktop videoconferencing and video e-mail with the integration of IP multicast routing in the PowerHub System Software, Release 2.4 or later.

While switching hubs are a viable solution for tackling the bandwidth problems associated with some multimedia applications, until now they have not been able to handle the flow of traffic created by videoconferencing or video broadcast.

IP multicast routing tackles bandwidth constrictions by providing one-to-many communication. It allows one user to send traffic to the PowerHub, which then forwards that traffic to selected groups of users for simultaneous use of interactive desktop applications.

• List price: *IP multicast routing for the PowerHub will be included free of charge in all PowerHub System Software Release, Versions 2.4 and later. Alantec, 2380 Bering Dr., San Jose, CA 95131-1121; 800-252-6832.*

Circle 951 on reader service card

NEW

Rockwell Continues Support for Dial-Up Routing

Rockwell International Corp.'s CMC Network Products group introduced a low-cost routing solution. The latest version of the NetHopper dial-up router, the NetHopper NH-P, provides network managers with ease of installation and ease of use. Rockwell's dial-up routers offer a cost-effective solution for file transfer, e-mail, and access to remote databases and the Internet. The NH-P features memory expansion from 1MB to 16MB, a modem upgrade path to the V.fast standard, and built-in dialer scripts for interoperability with other asynchronous products running the Point-to-Point Protocol.

• List price: *Rockwell NetHopper NH-P, $1,695. Rockwell International Corp., CMC Network Products, 7402 Hollister Ave., Santa Barbara, CA 93117-2590; 805-968-4262. Circle 953 on reader service card*

IMPROVED

Xyplex Expands Router Capabilities and Reduces Cost

Xyplex expands the functionality of its access-level routers while driving down their cost. Access-level routers are typically associated with easy configuration, concurrent bridging, and data compression. The 6220 Remote Bridge/Router now includes support for multiple wide area link options, including dedicated lines with speeds from 9,600 Kbps to T1/E1; packet-switched services such as frame relay and X.25; and circuit-switched services such as Switched 56, Public Switched Telephone Network, and ISDN. Xyplex also reduced the cost of the 6220 Remote Bridge/Router, as well as the 3210 Local Bridge/Router and the 6800 Remote Bridge/Router module. Additional advanced access-level routing features will be introduced at the end of this year and into the first quarter of 1994.

• List price: *Xyplex 6220 Remote Bridge/Router, $3,295; Xyplex 3210 Local Bridge/Router, $3,095; Xyplex 6800 Remote Bridge/Router, $2,995. Xyplex Inc., 330 Codman Hill Rd., Boxborough, MA 01719-1708; 508-264-9900; fax, 508-264-9930. Circle 954 on reader service card*

NEW

Lannet Reveals New Software Strategy

Lannet Data Communications offers enterprise-network management solutions for the multivendor environment. The MultiMan applications allow network managers to monitor and control their Lannet MultiNet and LANswitch hubs from within their native environment. These object-oriented applications provide a range of network management functions including port switching, monitoring, and alarm logging.

The first application in the series will be MultiMan/OV for the HP OpenView environment. The rest of the series will be available in the first quarter of next year. These will include MultiMan/SNM for integration with SunNet Manager, MultiMan/6000 for integration with IBM NetView/6000, and MultiMan/Win.

ENVIRONMENTALLY CORRECT: *Manage devices from within your native application.*

• List price: *MultiMan/OV, $5,995; pricing is not yet available for MultiMan/SNM, MultiMan/6000, or MultiMan/Win. Lannet Data Communications Inc., 7711 Center Ave., #600, Huntington Beach, CA 92647; 714-891-5580; fax, 714-891-7788. Circle 955 on reader service card*

BRIEFS

ADAPTERS

Kingston Technology Corp.'s new Dual Interface Adapter Card ($375) features IBM compatibility and IBM field service support. The Token-Ring adapter, part of the TokenRx line, is designed for IBM Micro Channel users. Additional features include multiple interfaces (DB-9, shielded twisted-pair, and unshielded twisted-pair) and compatibility with IBM adapter drivers. All major operating systems are supported, including OS/2, LAN Server, NetWare, Microsoft LAN Manager, and VINES. 800-435-2620, 714-435-2600; fax, 714-435-2699.

DigiBoard's newest adapter provides X.25 Public Data Network connections for NetWare LANs and WANs. The DigiBoard Synchronous Adapter for X.25 ($1,995) features a 20-MHz RISC processor and speeds up to 19.2 Kbps. Driver support for NetWare applications include NetWare Global Message Handling Services and NetWare Access Services 1.3*x*. 612-943-9020; fax, 612-943-5398.

HUBS

Racal-Datacom (LAN Internetworking Division) offers network managers what the company calls a complete network on a card. The 10BT-MGR is a 10BaseT module for the INX5000 intelligent wiring hub. The module features an on-board Simple Network Management Protocol (SNMP) agent, which eliminates the need for a separate management module and frees up ports for future expansion, reducing the overall cost of a total management/hub solution. The 10BT-MGR module is available now in 12-port ($2,095) and 24-port ($3,195) versions. 800-722-2555, 508-263-9929; fax, 508-263-8655.

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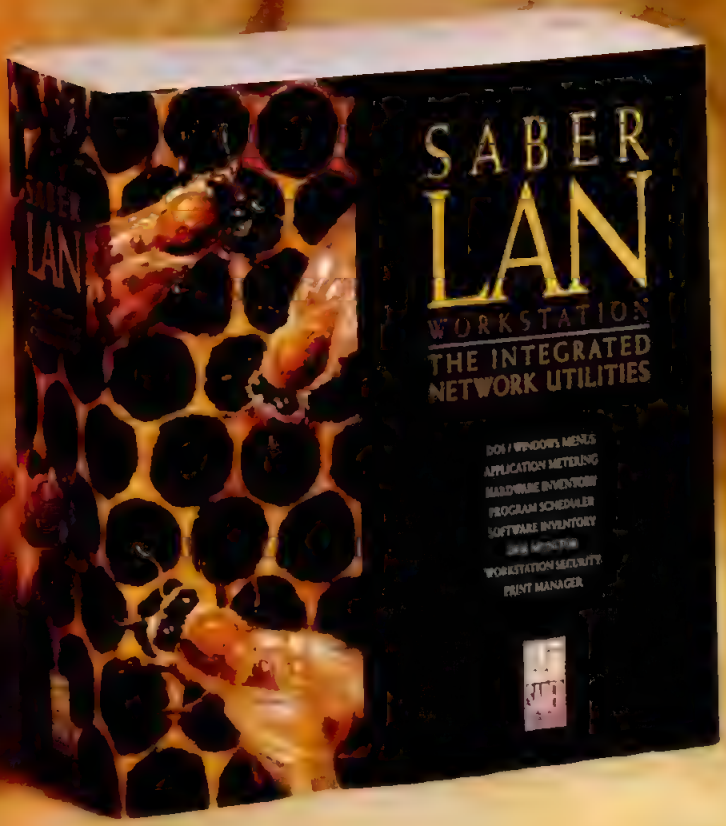

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NEW

Proteon Furthers Commitment to SNA Internetworking

Proteon enters the third phase of its four-part strategy to provide the industry's most complete and effective Systems Network Architecture (SNA) internetworking implementation. Previous steps included delivering mixed LAN connectivity and integrating SNA and non-SNA traffic. In an effort to stay in stride with IBM, the company is now emphasizing supporting migration to open standards by concentrating on LAN-to-LAN and LAN-to-WAN interoperability as well as network management.

Phase three includes the development of such emerging technologies as IBM's Data Link Switching (DLSw) and support for IBM's LAN Network Manager (LNM). By supporting the DLSw interoperability standard, Proteon strengthens its ability to help users move SNA traffic over multiprotocol internetworks. DLSw, which will be available in the first quarter of 1994, will include applications for local data link termination (SDLC-LLC2), SNA session support across TCP/IP, and Advanced Peer-to-Peer Networking.

In expanding its network management capabilities, Proteon will provide support of LNM in its family of bridging routers. The LNM protocol will allow the management of Token-Ring networks interconnected by source-routing bridges in SNA environments. The enhanced management scheme also includes the announcement of OneVIEW/pc, a Windows-based management platform for managing Proteon and other third-party devices. OneVIEW/pc features include point-and-click management, real-time device display, alarm notification, event logging, performance monitoring, and graphical icon representation.

• List price: *OneVIEW/pc, $2,995 to $3,995. Proteon Inc., Nine Technology Dr., Westborough, MA 01581-1799; 508-898-2800; fax, 508-366-8901.*
Circle 956 on reader service card

NEW AND IMPROVED

Qualcomm Delivers Interoperable E-mail

Qualcomm's new electronic mail software provides interoperability between PCs and Macintoshes across networks running under TCP/IP. Users of such networks can now send, receive, sort, and manage e-mail without the need for specialized e-mail gateways and servers, thereby reducing e-mail system costs. Eudora By Qualcomm is the first commercially available version of the Eudora e-mail software for global communication.

AVAILABLE TO THE MASSES: *Eudora manages e-mail over TCP/IP networks.*

Enhancements to the version that is currently being used on the Internet include message filtering for automatic sorting of messages by sender, subject, and text; and mobile access for dial-up connection via modem. Other capabilities that have been added to the Eudora By Qualcomm software include spell-checking, text editing, and the ability to enclose attachments.

• List price: *Eudora By Qualcomm, $50 (1 to 9 users); $45 (10 to 49 users); $40 (50 to 99 users); $36 (100 to 499 users); $32 (500 to 999 users); additional flat fee of $20 for the second platform (PC or Macintosh) for less than 100 users. Qualcomm Inc., 10555 Sorrento Valley Rd., San Diego, CA 92121-1617; 800-238-3672, 619-587-1121; fax, 619-452-9096.*
Circle 957 on reader service card

BRIEFS

HUBS

Optical Data Systems and **Windata**'s newly formed alliance will combine ODS' intelligent hub technology with Windata's expertise in wireless Ethernet connectivity. The result—ODS will resell Windata's FreePort Wireless Ethernet LAN System with its line of intelligent switching Infinity hubs. Infinity hub users can now take advantage of the benefits of wireless connectivity with transmission distances of up to 260 feet. ODS, 214-234-6400; fax, 214-301-3893. Windata, 508-393-3330.

CNet Technology announced a new intelligent hub and network management module for expanding and managing 10BaseT Ethernet networks. The CN4010TPC Hub ($895) features 12 modular unshielded twisted-pair ports, one AUI/BNC backbone interface, and two hub ports. To complete the package, CNet's CN4011TPC management module ($995) provides per-port network management, monitoring, and control for the new hub. 408-954-8000; fax, 408-954-8866.

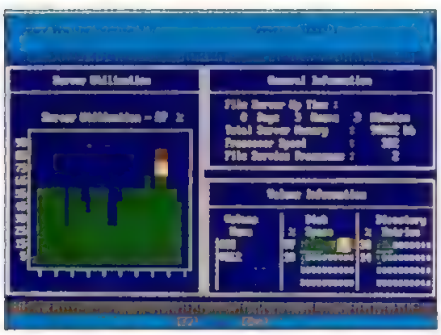
LANart Corp. introduced a series of both managed and unmanaged hubs to its Ethernet line. Designed for small fiber workgroups or fiber-optic backbones, the EFH0800 miniFiber Star ($1,995) supports eight 10Base-FL (FOIRL-compatible) ports for only $220 per port. Rounding out the additions to the new unmanaged hubs are the 12-port ETH1202 ($795) and the 16-port ETH1602 ($845) 10BaseT Workgroup Hubs. In the managed hub category, LANart introduced 12-port and 16-port workgroup hubs. The 12-port RS232-managed ETM1210 is $995. An SNMP version is available for $1,295. The 16-port RS232-managed ETM1610 is $1,095; its SNMP counterpart is $1,495. 617-444-1994.

IMPROVED

XTree Introduces New Management Tools and Features

XTree Co. improved two of its management applications. Designed specifically for the NetWare environment, XTreeNet, Version 3.0, and XTree Tools for Networks, Version 1.5, provide more power to the network manager through new tools and features.

XTreeNet, Version 3.0, is the first file manager that allows management of server volumes and disks on local or remote workstations. Network administrators now have the ability to recover deleted DOS files with the OOPS! Undelete for NetWare feature. Network managers can search for the deleted files by file name, file extension, file size, or last modified date. Other enhancements include File Usage Mode for information on who is accessing files and faster file compression and extraction with support for ZIP, Version 2.0. In addition, a text editor provides the ability to edit multiple files, record macros, sort files, and cut and paste between files.



FEATURES AND FUNCTIONS: *XTree adds control to Novell networks.*

XTree also expands network management, control, and monitoring features in XTree Tools for Networks, Version 1.5. Additional tools allow network administrators to choose between two methods of remote control: a TSR for DOS or a Windows remote capability available through the integration of Ocean Isle Software's Reach Out for Windows. Version 1.5 also features nonstop monitoring with WatchLAN and a multiwindow text editor for easier manipulation of files.

• List price: *XTreeNet, Version 3.0, $495; with server extensions, $295 each; XTree Tools for Networks, Version 1.5, $795 per server; each additional server, $595. XTree Co., 4115 Broad St., Building 1, San Luis Obispo, CA 93401-7993; 800-333-6561, 805-541-0604; fax, 805-541-4762.*
Circle 958 on reader service card

NEW

Sprint Offers ATM Service

Sprint emphasized its commitment to high-speed data communication with the demonstration of asynchronous transfer mode (ATM) service at Interop 1993. ATM is a set of international standards for sending large amounts of data, voice, and video information simultaneously over a network using extremely high transmission speeds.

Sprint's three-phase plan to provide a migration path to broadband networking began earlier this year with the implementation of frame relay services. Its second phase, ATM, is now available to the public. Sprint's implementation of ATM provides bandwidth on demand and many-to-many connectivity across a wide area using a public network. ATM operates over Digital Signal level three facilities and Synchronous Optical Network (SONET) transmission systems, depending on the bandwidth required. SONET is an international standard for fiber-optic transmission rates from 50 megabits per second (Mbps) to 13 gigabits per second (Gbps). The third phase in the migration to broadband service will be the change from a traditional transmission multiplexing system to SONET. Sprint plans to move to SONET in late 1994 or early 1995.

• List price: *Contact Sprint for pricing information. Sprint, 12490 Sunrise Valley Dr., Reston, VA 22096; 800-736-1130; fax, 913-541-6146.*
Circle 959 on reader service card

BRIEFS

SERVERS

Arnet Corp. announced a 16-port terminal server for use with multiple network protocols. NetTrax allows the connection of PCs, terminals, and printers to a small Ethernet network. The first NetTrax ($1,995) will be a TCP/IP version with support for RLOGIN, SNMP, and SLIP. 615-834-8000.

MultiFrame Servers' new Double Duty III server allows network managers to use NetWare's SFT Level III software. The server features dual computer systems, dual motherboards, dual power supplies, dual disk controllers, and dual hard drives in one case. If a component in the primary server fails, the secondary server will take over in 3 seconds. 510-655-7775; fax, 510-655-9298.

WIRELESS

Microsoft Corp. and **Intel Corp.** will provide users with the ability to send and receive e-mail without a telephone line. The companies introduced a Windows-based wireless e-mail solution for LAN-based e-mail. Using Intel's Wireless Modem ($747), remote users can connect to their office Microsoft Mail LAN server and exchange messages over the RAM Mobile Data wireless networks. Microsoft, 800-227-4679; Intel, 800-538-3373; RAM Mobile Data, 908-602-5500.

Retix and McCaw Cellular Communications' Wireless Data Division will provide routers for McCaw's Cellular Digital Packet Data (CDPD)-enabled network. Integrating Retix's RouterXchange 7000 with CDPD provides faster transmission rates and the ability to handle voice, data, and fax transmissions from the same unit. Retix, 310-828-3400; McCaw, 206-827-4500.

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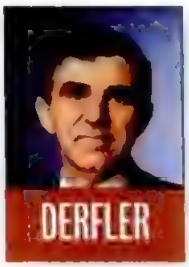
CIRCLE 878 ON READER SERVICE CARD

Too Much of a Good Thing?

So now SynOptics has joined Optical Data Systems in offering a 486-based server module for its wiring hubs. (Can Cabletron be far behind?) This concoction doesn't appeal to my appetite; I'd rather get my calories from whole-grain PCs.

David, let's ponder an Ethernet-switching, dual-power supply, UPS-backed wiring hub equipped with multiple fiber and copper cable connection modules, an internal router, a T-1 interface card, protocol analyzers, and one or more servers. I understand that Hughes Aerospace has a high-powered satellite under construction in Sunnyvale (suspiciously close to hub vendors David Systems, 3Com, and SynOptics) that is designed to send broadband signals to very small dishes. Let's put a 2-foot satellite dish on top of the wiring center's 19-inch rack. It'll be the cherry on the sundae!



We'll need a special room for the behemoth: one with glass walls, heavy air conditioning, and a raised floor for cabling. The person running this integrated system will need a new job title: Perhaps Aggregated Data Processing (ADP) Specialist will do.

Let's put a 2-foot satellite dish on top of the wiring hub. It'll be the cherry on the sundae!

Centralization isn't inherently good or bad, but in this case, too much centralization is regressive and perhaps dangerous. We are just now starting to use the PC revolution's gifts of distributed processing, and I don't feel good about physical consolidation. Distributing assets makes a system more reliable.

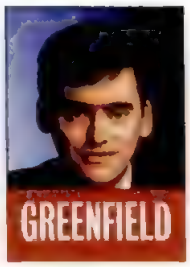
My experience shows that some supposedly standalone services—NetWare for SAA comes to mind—are much happier running on a real file server than under a runtime version of NetWare. So if there are some things I must consolidate in the file server, don't make me bunch them with the wiring hub too.

Please understand, Dave—I do like rack-mounted PCs. I think companies like Texas Microsystems that offer high-quality rack-mounted PCs are great. The rack-mounted PC is an excellent compromise between cleaning up the mess of cabinets and system reliability. Unlike the PC module in the wiring hub, rack-mounted PC s don't wed you to one vendor when they break because they have standard PC motherboards.

Like a gooey dessert, the idea of wrapping a server in a wiring hub cabinet is appealing in the short run, but not a good long-term strategy. Plain and simple rack-mounted fare keeps the system lean and flexible.

Frank, the more I study the wiring hub market, the more I'm convinced that I'm just looking at one big ice cream shop. Vendors are taking a plain vanilla idea—an empty chassis with slots for different types of modules—and adding all sorts of toppings. First we had the bridge and router in the hub. Then we got workstations and protocol analyzers in the hub. Now we've got the ultimate—a PC in the hub.

Have we gone too far? I don't think so, Frank. Putting PCs inside a hub lets you put specialty servers—gateways, fax servers, and the like—where they belong: in a highly resilient, manageable, and very flexible box.



Stop shuddering, Frank. The mere thought of putting servers in a hub shouldn't give you goose pimples. Servers, you've argued, belong in a secure, air-conditioned room anyway.

Communications servers, fax servers, and gateways are perfect candidates for the hub.

And I couldn't agree more. With file servers, you need those environmental and security provisions, particularly in corporations. Putting them inside a hub doesn't lend itself to those ends. And what good is the ability to remove a failed device from the network while the network is still running—one of the key reasons for inserting devices inside a hub—in a situation where users can't access the file server anyway?

But specialty servers such as gateways, communications servers, or fax servers are different. They are typically not mission-critical, and even when they are, the hub's internal cooling system is sufficient to keep the components functioning effectively.

In small, remote workgroups, cramming the server inside the hub makes even more sense. IS managers can ship a single hub with virtually all the hardware—file servers, communications servers, and (of course) a 10BaseT hub—preconfigured for a remote workgroup. Add PCs equipped with the right network adapters, and you've got a network. Ease of use is the draw for many customers. Just look at how SynOptics is targeting its Lattis Engine as a file server: It's pushing the server-in-a-hub concept not in its high-end 3000 line, but in its workgroup hub, the Model 2486.

The real question, Frank, is how long I will have to wait for the next great server module. And once I get that server module, will I be able to manage and configure it through the same management interface?

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A Better Echo Command

BY NEIL J. RUBENKING

PROTECTING YOUR START-UP FILES

When Install programs modify your AUTOEXEC.BAT and CONFIG.SYS files, the results can be irritating—or disastrous. Here's my solution for protecting start-up files.

- Create two bootable floppy disks. Copy your AUTOEXEC.BAT and CONFIG.SYS files to one of the disks and put it aside.
- On the other floppy disk, use DEBUG to find the string "AUTOEXEC.BAT" in COMMAND.COM and change the string to another filename. Since I work with mainframe computers, I chose IPL .BAT, short for Initial Program Load. Use spaces to pad the name portion to a full eight characters.
- Create two files on the disk, one dummy AUTOEXEC.BAT and one using the new filename you inserted in COMMAND.COM. Each file should consist of a single line that displays the name of the file; for example, `ECHO Booted from IPL.BAT`. It's a good idea to test the floppy disk by using it to boot your computer. You should see the message identifying IPL.BAT.
- Now rename your original AUTOEXEC.BAT—the one on your hard disk—to the new name. Copy the patched COMMAND.COM from the floppy disk to the one on the hard disk.
- Reboot from the hard disk. If your system won't boot with the modified COMMAND.COM, boot from the unmodified boot disk, copy the COMMAND.COM from that floppy disk to the hard disk, and restore your original AUTOEXEC.BAT.
- If all goes well, create a dummy AUTOEXEC.BAT file in your root directory. This file will receive any changes made by Install programs, so you can examine what they did; the changes won't be able to affect your new start-up batch file.

William C. Farrar
Duncanville, Texas

▶PC MAGAZINE: I'd like to expand on a few of the steps above, for those who aren't already DOS wizards. To create a bootable floppy disk, use FORMAT .COM's /S switch to transfer the system files MSDOS.SYS and IO.SYS to the floppy disk (IBMDOS.COM and IBMBIO.COM if you're running PC-DOS). COMMAND.COM will be copied to the disk at the same time.

If you use DOS 5.0 or higher and are willing to dig deep into your system files, you can protect CONFIG.SYS from intrusive Install programs.

Use DEBUG's S (Search) command to locate the string AUTOEXEC.BAT. After loading COMMAND.COM into DEBUG, type RCX and press Enter twice. DEBUG will return a hexadecimal number indicating the size of the file. The command

```
S CS:100 L #### 'AUTOEXEC.BAT'
```

where #### is replaced by the file size, will yield the address of that string. Now a command like

```
E CS:100 ####:#### 'IPL     .BAT'
```

where ####:#### is the address you found, will put the new start-up filename in place. Note that you *must* pad the file name portion to eight characters with spaces. Give the W command to write changes to disk, then the Q command to quit DEBUG.

You can also hide the start-up batch file in a subdirectory. Just use a name like XXX\AUTO.BAT and COMMAND .COM will run the file AUTO.BAT in the directory XXX. If you have DOS 5.0 or higher, you can use the ATTRIB command to set the hidden attribute for both AUTO.BAT and the directory XXX.

There should be only one copy of COMMAND.COM on your hard disk. If there's more than one, you can find out which copy DOS is using by entering `SET` at the DOS prompt and looking for a line containing COMSPEC=. The remainder of that line is the location of the active COMMAND.COM.

There's another level of protection available—for the brave. If you use DOS 5.0 or higher and are willing to dig a little deeper into your system files, you can also protect CONFIG.SYS from intrusive Install programs. Here's how: In the first step above, also copy the programs SYS.COM and ATTRIB.EXE to the two boot floppy disks. After you successfully patch COMMAND.COM to use your al-

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ternate start-up batch file, repeat the second and third steps to find and change the filename CONFIG.SYS in the system file, IO.SYS (or IBMBIO.COM).

Before you can load IO.SYS into DEBUG, you have to remove its read-only, hidden, and system attributes by using the command

```
ATTRIB -R -H -S IO.SYS
```

When you search for the string 'CONFIG.SYS', you'll get back several addresses—use the first. Replace CONFIG with another six-letter filename, perhaps FIGCON.SYS or XXX\CO.SYS. Then restore IO.SYS's original attributes with the command

```
ATTRIB +R +H +S IO.SYS.
```

To test the changed IO.SYS, create a file on the floppy disk using the name you chose, and put any nonvalid CONFIG .SYS line in it. Reboot the system, and look for the error message caused by your nonvalid line. To transfer the changed IO.SYS to your hard disk, use the SYS.COM program that you copied to the floppy disk; for example, you would type A:SYS C:. Rename your CONFIG.SYS file to the new name you chose, and reboot from the hard disk. If the hard disk won't boot, reboot from the unmodified floppy disk and use SYS to transfer the unmodified IO.SYS back to the hard disk, then restore the original name of CONFIG.SYS. Just to be safe, you may want to back up your boot drive before attempting this procedure.

This may seem like a lot of trouble just to prevent Install programs from modifying your start-up files. It just depends on how much time and effort you've invested in optimizing those files. You can apply this technique in 15 minutes, while it might take hours of trial and error to recover from an Install program that badly trashed your start-up files.

A BETTER ECHO COMMAND

If I had a dollar for every batch file that relies on a separate little data file containing a line of text with no carriage return or line-feed, it might not make me rich but it would certainly pay for a good meal. I've waited for years for someone to write a little program to simplify and automate this process, and I finally decided to do it myself.

Redirecting the following script:

```
A100
MOV CL,[80]
SUB CL,2
JBE 115
MOV BX,82
MOV AH,2
MOV DL,[BX]
INT 21
INC BX
LOOP 10E
INT 20

N STYPE.COM
RCX
17
W
Q
```

into DEBUG results in the program STYPE.COM. STYPE is similar to the ECHO command except that the last character will not be echoed and there will be no trailing CR/LF. You can use the program to send messages to the screen or redirect them to a file, and it can be useful in batch files to create any necessary file using I/O redirection at the time the file is needed. STYPE can also be used to echo messages without a CR/LF at the end.

Here's an example. TRASHOUT .BAT, presented in the November 24, 1992, column, requires that TRASHOUT.DAT—containing only the word *trashout*—be present on-disk before you run it. With STYPE, the TRASHOUT .DAT file would not have to exist ahead of time. Instead it could be created automatically whenever needed with the following command:

ECH.SCR

Complete Listing

```
N ECH.COM
A 100
MOV     SI,0082     ; SI points to command tail
SUB     CH,CH       ; zero out CH
MOV     CL,[SI-02]  ; character count in CL
JCXZ    0113        ; no command tail?  skip it!
DEC     CX          ; deduct one for the skipped space
LODSB               ; get a char into AX
XCHG    DX,AX       ; get the char in DL
MOV     AH,02       ; select write character function
INT     21          ; call INT 21h
LOOP    010B        ; go back for the next character
INT     20          ; call INT 20h (terminate process)

RCX
15
W
Q
```

Figure 1: **ECH.COM, which this script creates, is another ECHO replacement. But this version echoes its command line exactly; it doesn't append a CR/LF either.**

ECHZAMPL.BAT

Complete Listing

```
@ECHO OFF
REM ECHZAMPL.BAT - demonstrates ECH program
REM   (ECHO with no CR/LF)
IF NOT '%1'=='' GOTO WasteTime
ECH Working.
FOR %%v IN (x x x x x x x x x x) DO CALL %0 %%v
ECHO Done!
GOTO Done

:WasteTime
DIR \ > NUL
ECH .
:Done
```

Figure 2: **This batch file shows one possible use for ECH.COM.**

```
STYPE trashout ?>TRASHOUT.DAT
```

Any character could replace the question mark. The reason STYPE ignores the last character is so that the output can include trailing spaces. Most text editors remove trailing spaces.

Frank T. Clark
Bethlehem, Pennsylvania

▶PC MAGAZINE: A lot of batch file techniques would be easier to implement if the DOS ECHO command had a switch to suppress the carriage return and linefeed at the end of each line. Since it doesn't, we have to work around that lack—or provide the needed function with an external program. STYPE.COM does the job, as long as you remember that the last character of the output line won't be echoed.

It's worth noting that DOS does include trailing spaces when they precede a redirection symbol. Try it. Enter the three commands

```
STYPE 1 > GETRID.1
STYPE 2  > GETRID.2
STYPE 3   > GETRID.3
```

where the lines contain one, two, and three spaces before the redirection symbol. Now type `DIR GETRID.?` and you'll see that each file is one character larger than the preceding.

If you don't need the last character removed, you may want to try my own ECH .COM, created by the DEBUG script in Figure 1. I've used this one myself for some time. To create either program, redirect the script into DEBUG using a command like `DEBUG < ECH.SCR`.

The batch file ECHZAMPL.BAT in Figure 2 shows another possible use for an ECHO-like command that doesn't append a CR/LF. It simulates a batch file that performs a time-consuming, repetitive procedure. To let the user know *something* is happening, it writes a period to the screen between repetitions. In the example, the time-consuming procedure is nothing more than reading the root directory, but the resulting output has quite a professional look.

You can download the files mentioned here from PC MagNet's Utilities/Tips Forum, archived as ECHO.ZIP. □

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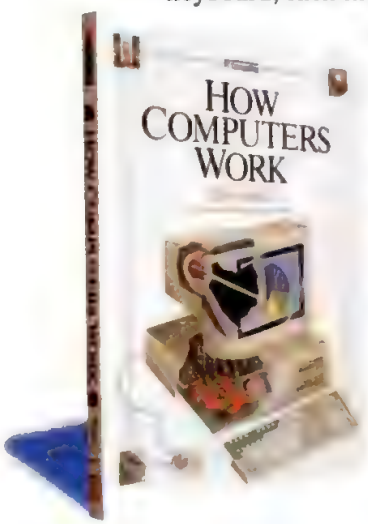

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Writing DOS Utilities with DEBUG, Part 3

BY JEFF PROSISE

In the past couple of issues, we've learned how to create small but useful assembly programs with the miniassembler built into DEBUG. So far, we've learned a few assembly language instructions, such as MOV and INT, and been exposed to some of the programming services available in the DOS kernel. This time we'll concentrate on services available in the PC BIOS.

The BIOS is a collection of assembly language subroutines stored in ROM. Some of these subroutines are executed every time your PC is powered up, as part of the power-on self-test (POST). The majority, however, are there to help programs communicate with PC devices such as the keyboard, the video adapter, printers, and disk drives. This issue, we'll use a few of these services to create some compact but powerful new utilities.

READING THE SHIFT KEYS If you've been following this series, you'll recall the GETKEY program we concocted in the September 28 article. GETKEY used one BIOS programming service—interrupt 16h, function 00h—to read a key code from the keyboard buffer, and then it returned an exit code equal to the key's ASCII code. We also mentioned interrupt 16h, functions 01h and 02h. Function 01h sets a flag that lets a program know if a key code is awaiting processing in the keyboard buffer, while function 02h returns a series of bit flags in AL reflecting the state of the four shift keys (Right Shift, Left Shift, Ctrl, and Alt), the three lock states (NumLock, CapsLock, and ScrollLock), and the Insert state. Bits 0 through 3 correspond to the Left Shift, Right Shift, Ctrl, and Alt keys, respectively. If bit 2 is set to 1, for example, then the Ctrl key is currently depressed. If bit 2 is 0, then the Ctrl key is not depressed. On an enhanced keyboard, which has two Ctrl keys, this bit is set if either or both of the Ctrl keys is held down. (Note that assembly language programmers use the term *set* to mean the bit is equal to 1; conversely when you *clear* a bit, you make it equal to 0.)

Interrupt 16h, function 02h provides programmers with a convenient vehicle for checking the state of the four shift keys. Suppose you want to write a utility that returns an exit code that a batch file can use to determine whether the Left or Right Shift key is pressed. In DEBUG, such a utility might look like this:

This part of our assembly language minicourse teaches you about functions in the BIOS, the logical AND and OR instructions, indirect addressing, and loops.

```
A 100
MOV AH,02
INT 16
AND AL,03
MOV AH,4C
INT 21

N GETSHIFT.COM
RCX
0A
W
Q
```

GETSHIFT.COM works as follows: First it calls interrupt 16h, function 02h to read the shift status byte into AL. Since we need only bits 0 and 1, which correspond to the Right and Left Shift keys, GETSHIFT then zeros bits 2 through 7 with the instruction `AND AL,03`.

The assembly language AND instruction performs a logical AND between two values, leaving the result in the register or memory location to the left of the comma. The term *logical* AND comes from the field of Boolean logic, which uses the operators AND, NOT, and OR to make decisions. For example, you might have the logical statement "If it's sunny outside AND the tide is low, I'll go fishing." Logically, only if both the statements surrounding the AND are true will the action at the end take place. In the case of computers, you're evaluating relationships between *bits*. When dealing with bits, you can consider 1 to be equivalent to a true statement and 0 a false one. So if you're comparing bits with AND, you'll get the following results:

```
0 AND 0 = 0
0 AND 1 = 0
1 AND 0 = 0
1 AND 1 = 1
```

Notice that only when both bits are 1 will the result be 1. In the statement `AND AL,03`, the value in AL is ANDed with 03h, which is equal to 00000011 binary. When it ANDs one byte value with another, the CPU ANDs each bit of the first byte against the corresponding bits of the second byte. ANDing the value 5Ah (01011010 binary) with 03h would produce the following result:

```
      0 1 0 1 1 0 1 0    (5Ah)
AND   0 0 0 0 0 0 1 1    (03h)
      ===============
      0 0 0 0 0 0 1 0    (02h)
```

As you can see, ANDing 5Ah with 03h effectively masks the upper 6 bits, leaving the lower 2 bits intact. Once the upper bits are masked out, GETSHIFT uses DOS function 4Ch to terminate and return the exit code in AL. GETSHIFT returns an ERRORLEVEL code equal to 3 if both Shift keys are pressed, 2 if the Left Shift key is pressed, 1 if the Right Shift key is pressed, or 0 if neither Shift key is pressed.

Could such a utility ever come in handy? You bet. Suppose your AUTOEXEC.BAT file loads a pair of TSRs named MOUSE and NETWORK. Together these programs require more than 80K of memory, and you'd like to modify AUTOEXEC.BAT so that you can boot without these programs by pressing and holding a Shift key as your PC starts up. The following batch file commands would do the trick:

```
GETSHIFT
IF ERRORLEVEL 1 GOTO NO_TSRS
MOUSE
NETWORK
:NO_TSRS
```

Now, if either one or both Shift keys are depressed when your AUTOEXEC .BAT file executes the GETSHIFT command, the MOUSE and NETWORK commands will be skipped.

TURNING NUMLOCK OFF A lot of PCs boot up with the NumLock keypad light on. This is annoying if you like to use the arrow keys on that keypad. Now suppose you'd like to create a utility that turns NumLock off each time your PC starts up. Interrupt 16h, function 02h returns a bit flag (bit 5 of the AL register) that indicates whether NumLock is on or off. But function 02h makes no provision for setting the NumLock state, nor does any other BIOS function. Now it is time to turn to a programming resource that is related to the BIOS, but that doesn't involve a BIOS function call: the *BIOS data area.*

The BIOS data area is a 256-byte region of conventional memory that begins at absolute address 400h (the 1,024th byte in memory) or in segment:offset form: 0040:0000 (or just 40:00 for short). To access values stored in it, programmers usually load a segment register with the segment address 40h. Then the first byte in the BIOS data area lies at offset 0 from the base of the segment, the second byte lies at offset 1, and so on. Within this 256-byte region is an assortment of useful values stashed away by the BIOS—values, for example, that control the NumLock state and the location (and length) of the keyboard buffer. The BIOS itself is stored in ROM, and data can't be written to ROM; that's why the BIOS claims 256 bytes of RAM for its own use. DOS loads higher in memory than the BIOS data area, so as far as DOS is concerned this region is safely reserved for the BIOS.

The byte that we're interested in is the one that lies at offset 17h from the base of the BIOS data area segment; it's known as the *BIOS shift status byte.* The format of this byte is identical to that of the shift status byte returned in AL by interrupt 16h, function 02h. In fact, all function 02h really does is retrieve this byte from the BIOS data area, place it in AL, and return to the caller. Bit 5 of the BIOS shift status byte determines whether NumLock is enabled or disabled. By setting or clearing bit 5, a program can mimic the action of the NumLock key and enable or disable NumLock. If you looked inside the BIOS at the code that handles key presses, you'd find that all the BIOS does when you press the NumLock key is toggle this bit from 0 to 1 or 1 to 0. On most PCs, the code that toggles the keyboard's NumLock light on or off lies elsewhere in the BIOS, and it works in the background to keep the indicator light in sync with the NumLock bit. Therefore, setting the NumLock bit to 0 or 1 toggles the NumLock state *and* toggles the NumLock light to reflect the bit's new state (the indicator light doesn't automatically toggle on some PCs, but these are the exception rather than the rule).

Now that you understand how NumLock is toggled on and off, here's the DEBUG script for creating a short program that turns NumLock off. First the program loads the value 40h into the DS register so that the bits and bytes in the BIOS data area are accessible. Then it uses an AND instruction to set bit 5 of the byte at 40:17 (segment 40h, offset 17h) to 0 while leaving the other bits intact. Finally, it calls DOS function 4Ch to terminate and return to the DOS prompt.

```
A 100
MOV AX,40
MOV DS,AX
AND BYTE PTR [17],DF
MOV AH,4C
INT 21

N NUMOFF.COM
RCX
0E
W
Q
```

Two parts of this program should be scrutinized more closely. First, the DS register is loaded with the value 40h, with the instructions

```
MOV AX,40
MOV DS,AX
```

Why didn't we just use one MOV instruction, as in `MOV DS,40`? Because Intel's 80x86 processors do not allow immediate values (values hardcoded into the program, as opposed to values stored in registers or memory locations) to be moved into segment registers. They do, however, permit register values to be moved into segment registers. Thus we fill AX with the value 40h first, and then transfer the value in AX to DS.

The second item of interest is the instruction

```
AND BYTE PTR [17],DF
```

which clears bit 5 of the byte at offset 17h from the base of the segment whose address is contained in the DS register. You already know how the AND instruction works, but other parts of this instruction may seem cryptic. In assembly language, a number placed in brackets specifies an offset address, not an immediate value. In this case, [17] refers to the byte at offset 17h. Again the offset is calculated relative to the segment address stored in the DS register, which in this case is 40. Thus, [17] means "17 bytes from the beginning of segment 40h," or 40:17. BYTE PTR tells DEBUG that you're referring to the *byte* at offset 17h. Without this directive, DEBUG won't know whether you mean

a byte or a word. The instruction `AND BYTE PTR [17],DF` ANDs the byte value stored at 40:17 with DFh and leaves the result at 40:17. Since DFh is equal to 11011111 binary, bit 5 is set to 0 and all other bits in the byte are left unchanged (remember, bits are numbered starting with 0). Notice how ANDing a bit with 1 leaves it unchanged—1 AND 1 is 1, 0 AND 1 is 0. But no matter what the value of a bit, ANDing it with 0 results in 0.

To try out NUMOFF.COM, just type `NUMOFF` at the command prompt. NumLock should now be disabled. (You can add this command to your AUTOEXEC.BAT file if you want to disable NumLock each time you boot up your system).

You could easily modify this DEBUG script to turn off CapsLock (bit 6 of the BIOS shift status byte) or ScrollLock (bit 4). Changing

```
AND BYTE PTR [17],DF
```

to

```
AND BYTE PTR [17],BF
```

for example, would alter the program so that it turned CapsLock off. Conversely, changing this instruction to

```
OR BYTE PTR [17],40
```

would turn CapsLock on, not off, by setting, not clearing, bit 6. OR is another logical instruction like AND, but its logic works a little differently. To continue our example: "If it's sunny OR the tide is low, I'll go fishing." In this case, if any of the statements connected by OR are true, then the statement "I'll go fishing" will also be true. Likewise, when comparing bits with OR, you get the following results:

```
0 OR 0 = 0
0 OR 1 = 1
1 OR 0 = 1
1 OR 1 = 1
```

An OR operation sets a bit to 1 if either or both of the bits in the two values being ORed is 1. ORing the two arbitrary byte values 5Ah and F0h would produce the following result:

```
   0 1 0 1 1 0 1 0 (5Ah)
OR 1 1 1 1 0 0 0 0 (F0h)
   ===============
   1 1 1 1 1 0 1 0 (FAh)
```

Notice how, just as ANDing any bit with 1 leaves it unchanged, ORing any bit with 0 leaves it unchanged. In our case, ORing the BIOS shift status byte with 40h (which is 01000000 binary) ensures that bit 6 is set to 1 while leaving all other bits unchanged.

CHECKING DRIVE READINESS One utility that batch file programmers often find useful is one that determines whether drive A: is ready. *Ready* means the drive contains a disk and the drive door is closed. The interrupt 13h disk services in the BIOS make it easy enough to write such a utility. Specifically, you can use interrupt 13h, function 02h, which reads one or more sectors from a disk.

The following DEBUG script creates a utility named ISAREADY.COM, which checks drive A: and returns an exit code of 0 if the drive is ready. If the drive is not ready, the exit code is nonzero. It's a little more involved than the DEBUG scripts we've worked with thus far, so look at it closely.

```
A 100
MOV CX,0003
PUSH CX
MOV AX,0201
MOV BX,0200
MOV CX,0001
MOV DX,0000
INT 13
POP CX
JNC 0117
LOOP 0103
MOV AL,AH
MOV AH,4C
INT 21

N ISAREADY.COM
RCX
1D
W
Q
```

Here's how ISAREADY works. First CX, which is used as a loop counter, is set to 3. ISAREADY tries to read a sector from the disk in drive A: up to three times, and only concludes that the drive is not ready if all three attempts fail. The loop is effected by the instructions

```
PUSH CX
.
.
POP CX
.
.
LOOP 0103
```

The instructions `PUSH CX` and `POP CX` save the value of CX on the stack and restore it, respectively. (The *stack* is an area of memory which, among other things, gives programmers a convenient place to store information temporarily by PUSHing and POPing. A value PUSHed onto the stack can be restored by POPing it back off. If more than one value is PUSHed onto the stack, values are POPed off in the reverse order from that in which they were PUSHed on.)

This saving and restoring is necessary because the code inside the loop alters the value of CX. The LOOP instruction decrements CX by 1 and tests the result. If CX is now 0, the LOOP instruction does nothing and processing falls through to the next instruction.

Otherwise, execution goes to the specified offset. In this case the offset is 0103h, which is the address of the instruction PUSH CX. Therefore, unless something happens to prevent the LOOP instruction from being executed, the instructions between PUSH CX and LOOP 0103 will be repeated exactly three times.

It's what's inside the loop that's important. The instruction sequence

```
MOV AX,0201
MOV BX,0200
MOV CX,0001
MOV DX,0000
INT 13
```

reads one sector from the disk in drive A: using interrupt 13h, function 02h. Function 02h accepts several input parameters: a function code in AH, the number of sectors to be read in AL, the address that the data will be copied to in ES:BX, a track number in CH, a sector number in CL, a head number in DH, and a drive number in DL. ISAREADY at-

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tempts to read one sector—head 0, track 0, sector 1, which is the very first sector on the disk—from the disk in drive 0 (A:).

BX is initialized to 200h before the call, and ES holds the program's own segment address (CS, DS, ES, and SS all contain the program's segment address when a COM file is started). The program itself spans offsets 100h through 11Ch, so the data read from the disk is copied to unused memory beyond the end of the program code.

You may recall from the first article in this series that there's a register named FLAGS that holds bit-sized flags (basically on/off switches) that are referenced by other assembly language instructions. One of these flags is the *carry flag*, which is used by the BIOS function we're concerned with here. After the call is made with the `INT 13` instruction, the carry flag indicates success or failure. Carry set means the call failed, and that the drive is not ready; carry clear means the sector was successfully read.

After executing these instructions, ISAREADY branches past the LOOP instruction to the instruction at offset 117h (`MOV AL,AH`) if the carry flag is clear. It does this via the instruction

```
JNC 0117
```

That JNC means "Jump if No Carry," or jump if the carry flag is not set. If carry is set, execution falls through to the LOOP instruction and the sequence is repeated (provided this isn't the third time through the loop). Note that CX is popped off the stack before the JNC instruction. Be careful: Some instructions affect the carry flag. It just so happens that POP does not, so it's okay to POP a value off the stack before a JNC instruction. POPing CX cleans up the stack (every PUSH should be countered by a POP statement so that no data is left on the stack when the program terminates) and restores the counter value to CX.

The instructions

```
MOV AL,AH
MOV AH,4C
INT 21
```

close out the program the way we have in previous examples. Interrupt 13h, function 02h also indicates success or failure by the value returned in AH. If AH is 0, then the call succeeded; if AH is not 0, then the call failed. ISAREADY copies the return value in AH to AL to use as an exit code.

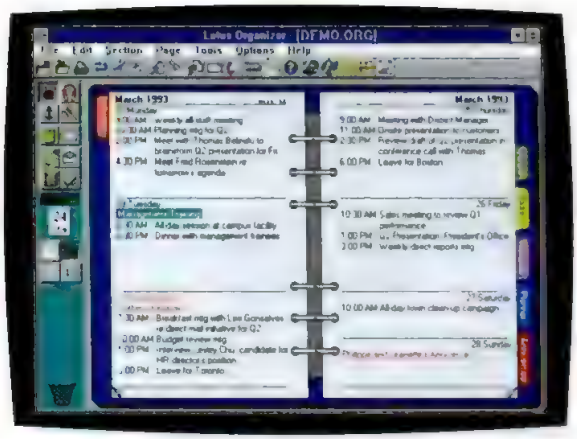
Execution can reach this point in the program in either of two ways: If the drive is not ready, the LOOP instruction will fall through after the third try and AH will contain a nonzero error code. If the drive is ready, the JNC instruction will jump to the `MOV AL,AH` instruction after a successful read and AH will contain 0, indicating that the disk was read. In either case, AH will hold the proper exit code. It's important for the program to test the drive more than once if function 02h fails, because function 02h will nearly always fail the first time it's called after a disk is inserted into the drive or if the drive was not ready the last time the function was called.

You can test ISAREADY with this short batch file:

```
@ECHO OFF
ISAREADY
IF ERRORLEVEL 1 GOTO ERROR
ECHO Drive A: is ready
GOTO END
:ERROR
ECHO Drive A: is not ready
:END
```

You can modify ISAREADY to check drive B: instead of A: by changing the line `MOV DX,0000` to `MOV DX,0001`.

FURTHER READING We could never hope to cover all of the BIOS programming functions in this column, but this discussion should give you a taste of how they are used. For further reading, check your local bookstore for programming reference books that summarize BIOS functions. There are several such books available, among them the recently updated classic, now called *The Peter Norton PC Programmer's Bible* (Microsoft Press, 1993). The official reference to BIOS functions is contained in *Personal System/2 and Personal Computer BIOS Interface Technical Reference*, an IBM publication that you can order by calling 800-426-7282. The *BIOS Interface Technical Reference* also documents the contents of the BIOS data area. □



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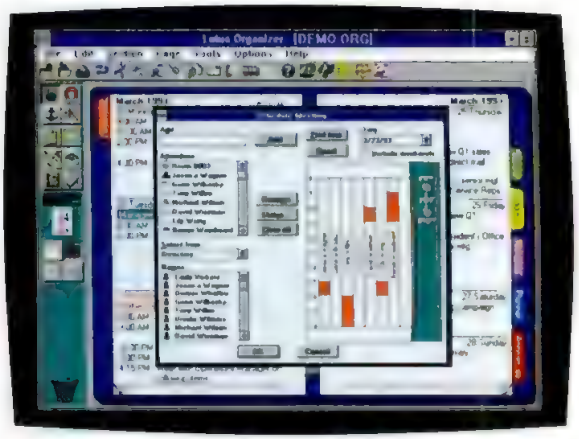

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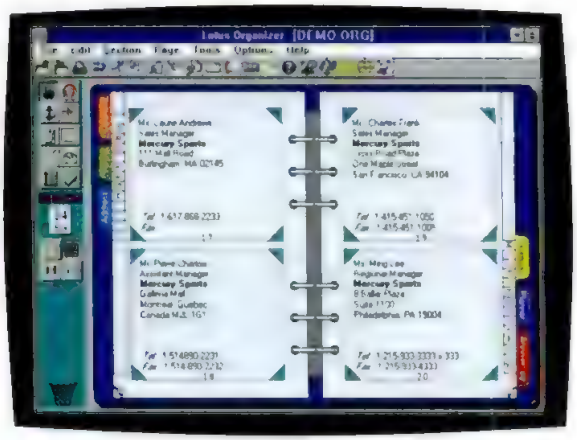

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Understanding and Using Pointers in C

BY DOUGLAS BOLING

If you program in C, you can't avoid pointers altogether, but you probably try to minimize their use. You're not alone: The mere mention of pointers chills the hearts of even the most experienced C programmers. The very power of C pointers brings with it a complexity that all too often results in "write-only" code—the kind of code even *you* can't understand after you've written it.

In this Lab Notes I'll try to take some of the mystery out of using C pointers. I'll start with the basic concepts and proceed to some fairly complex uses, so programmers with different levels of C experience can profit from the discussion. You'll find that once you understand C pointers, the power of pointer logic will greatly reduce the amount of code you need to write to accomplish nearly any C programming task.

POINTER BASICS Simply put, a pointer is a variable that contains the address of another variable. That address is the place in memory where the program stores the value of the variable. The address and the value have operators specifically associated with C pointers.

The & operator is used to indicate the *address* of a variable. Thus, &X represents the address at which the value for X is stored. The address of a variable, X, can be assigned to another variable, PtrX, with a simple assignment:

```
PtrX = &X;
```

Once so assigned, the variable PtrX *points to* the variable X and therefore is a pointer to X.

The inverse of the & operator is the * operator. (This unary * operator should not be confused with the * operator that is used to denote the binary operation of multiplication.) If PtrX is a pointer to the variable X, then *PtrX represents the *value* of X.

New and experienced programmers alike can improve their code and avoid hard-to-find errors by studying this discussion of a difficult topic.

To illustrate, both of these code fragments assign 5 as the value of X:

```
/* A typical variable
 assignment. */
X = 5;
```

and

```
/* Pointer pX is assigned the
 address of variable X  */
pX = &X;
/* The memory location pointed
 to by pointer pX is set to
 the value 5 */
*pX = 5;
```

This example shows that once a pointer variable has been assigned the address of another variable, the notation

```
*pointer_variable
```

can be used interchangeably with the variable name itself. The following code sets Y to twice X.

```
/* Pointer pX is assigned the
 address of variable X  */
pX = &X;
/* Y is assigned X + X */
Y =  X + *pX;
```

Note that since the * operator has a higher precedence than the + operator, the combination of the * operator and the variable pX gets processed before the addition. The higher an operator's precedence, the earlier it is evaluated in an expression. The pointer operator * has a higher precedence than all but a handful of C operators.

Similarly, an equation such as

```
Y = 200 / *pX;
```

assigns Y the value 200 divided by the value pointed to by pX, since the * operator has a higher precedence than the / division operator.

You'll have noticed that I've indicated the pointer variable by prefixing the original variable name with a lowercase p. While not required, this notation is a convenient way to indicate that a particular variable is a pointer and just what that pointer should be pointing to! With only a few exceptions, I'll continue this naming practice below; but remember, the name of the pointer has no impact on what the variable points to.

Like other variables, pointer variables must be declared. The standard syntax for declaring a pointer is the data type the pointer points to, followed by the * operator. For example, a pointer to an integer would be declared thus:

```
int   *pSize;
```

This pointer declaration is best understood by reasoning that the combination of the * and the pointer name pSize is declared to contain the address of a 2-byte integer variable. (An integer is 2

bytes in size in 16-bit operating systems such as DOS and Windows.) While normal variables generally isolate you from knowing such implementation details as how many bytes they take up in memory, pointers tend to expose all of the nasty details.

The code fragment shown in Figure 1 will serve to review the basic pointer concepts. The comments on each line indicate what the line does. Remember, the address of a variable is returned using the & operator. Once a pointer points to the address of a variable, the combination of the * operator and the pointer name becomes an alias for the variable itself.

PRECEDENCE AND ASSOCIATIVITY I mentioned earlier that the * and & operators have a high precedence in the ranking of C operators. Figure 2, taken from the classic text, *The C Programming Language*, by Kernighan and Ritchie, shows the precedence for all C operators. The higher in the table the operator is listed, the higher its precedence.

The *associativity* of an operator determines whether a value in an expression is to be associated with an operator immediately to its left or to its right. The pointer operators * and & have right-to-left associativity, which means that a variable name with an * immediately to its left will not be interpreted as the variable itself, but as the data to which the variable points.

Operators on the same row in Figure 2 have the same precedence. This means that the * and & operators that deal with pointers are of the same precedence as the type casting operator (type), which I'll discuss below. This equal precedence can be the source of many a bug, as you'll soon see.

ARRAYS AND POINTERS C pointers and arrays are so closely related that they are often used almost interchangeably. Arrays are implemented as a series of memory locations, each holding a value. As shown in Figure 3, for example, an array of characters is implemented as a series of consecutive memory locations, each byte containing one character.

Note that the string stored in the array in Figure 3 is terminated by a zero byte. This zero byte does not terminate the array; it is simply an additional character that indicates the end of the string. Inexperienced C programmers often forget to allow space in an array for the terminating zero.

C takes the array/pointer equivalence even further by assuming that an array name without an index is actually a pointer to the base of the array. Thus, instead of saying

```
char     Array[20];
char     *pArray;

pArray = &Array;  /* Wrong! */
```

the pointer assignment is written as

```
char     Array[20];
char     *pArray;

pArray = Array; /* Correct */
```

By starting off at the base of an array, pointers can be used to "walk" through the array. Suppose, for example, that a character pointer points to the first member of a character array. If you simply increment the pointer, the pointer will point to the second member of the array. Thus, the expression

```
char = Array[3];
```

is equivalent to

```
/* Point pArray to the base of
 the array */
pArray = Array;
/* Now point pArray to the
 third member */
pArray = pArray + 3;
char = *pArray;
```

Notice that in the preceding example the expression

```
pArray = pArray + 3
```

did *not* use the * pointer operator. This is because you want to change the pointer itself in this line, not the value to which the pointer points. If instead you had written the expression as follows:

```
*pArray = *pArray + 3
```

Operator Precedence and Associativity

	Operator	Associativity
1	( ) [ ] -> .	Left to right
2	* & ! ~ ++ -- (type) sizeof	Right to left
3	* / % (Multiplication)	Left to right
4	+ -	Left to right
5	<< >>	Left to right
6	< <= > >=	Left to right
7	== !=	Left to right
8	& (Bitwise AND)	Left to right
9	^	Left to right
10	|	Left to right
11	&&	Left to right
12	||	Left to right
13	?:	Right to left
14	= += -=	Right to left
15	,	Left to right

Figure 2: **The order in which operations involving more than one operator are executed in C depends on their precedence. An operator's associativity indicates whether a value in an expression is linked to an operator immediately to its left or right.**

Pointer Syntax

Sample Code

```
int     Size, Color;     /* Define 2 integers, Size and Color */
int     *pSize;          /* Define pSize, a pointer to an integer. */
Size = 32;               /* The variable Size is assigned the value 32. */
pSize = &Size;           /* The pointer pSize is assigned the address
                            of variable Size  */
Color = *pSize;          /* Color is assigned the value at the
                            address pointed to by pSize. */
                         /* Since pSize points to Size, and Size
                            is 32, Color is assigned 32. */
Color = 40;              /* Color is now set to 40, instead.  The other
                            variables are unaffected. */
*pSize = 50;             /* By setting *pSize to 50, we set Size to 50. */
```

Figure 1: **The code example above illustrates the fundamental pointer concepts.**

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String Storage

```
char szName[10] = "Douglas" /* Declare a 10 character array initialized with
                               the string Douglas. */
                        |
                        |
In memory               -------> Array address +0  'D'
                                                +1  'o'
                                                +2  'u'
                                                +3  'g'
                                                +4  'l'
                                                +5  'a'
                                                +6  's'
                                                +7   0
                                                +8   Don't care
                                                +9   Don't care
```

Figure 3: **C arrays are stored in memory in consecutive addresses. The zero byte at offset 7 terminates the string, but not the array.**

Increment Operations

Sample Code

```
char ch;          /* Declare a character variable */
char *pChar;      /* Declare a pointer to a character */

ch = *pChar++;    /* Assign the value pointed to by pChar to ch,
                     then increment pChar.*/

ch = *++pChar;    /* Increment pChar, then assign the value
                     pointed to by pChar to ch. */

ch = ++*pChar;    /* Increment the value pointed to by pChar,
                     then assign value to ch*/

ch = (*pChar)++;  /* Assign the value pointed to by pChar to ch,
                     then increment the value pointed to by pChar.*/
```

Figure 4: **Because increment and decrement operators have the same precedence rank as pointer operators, combinations must be handled carefully in order to achieve your intended meaning.**

you would only have added 3 to the first member of the array.

This example brings up one caution about pointer arithmetic. It is important to get clear about exactly what happens in each case. In the case of character arrays, each character occupies 1 byte in memory, so adding 3 to a character pointer actually adds 3 to the address contained in the pointer.

In the case of data types that take up more than 1 byte of space, however, the value added to the pointer is *not* the increment value, but the increment value multiplied by the size of the data type. For example, when a pointer to an array of integers is incremented, the pointer value is increased by 2, since an integer takes 2 bytes of memory in a 16-bit environment such as DOS or Windows. I'll return to this theme in connection with type casting, below.

Individual elements in an array are treated as single variables. For example, the third element in an array is addressed as Array[2]. To assign a pointer to point to an individual element, the "address of" operator, &, must be used, since an element of an array is simply another variable. An example may make this easier to grasp:

```
char Array[] = "Doug";
char *pThirdElement;
pThirdElement = &Array[2];
```

INCREMENTING AND DECREMENTING As all C programmers soon discover, the increment ++ and decrement -- operators are very handy. While a convenient shorthand for expressions such as X = X + 1, these operators really come into their own when used with pointers. The increment and decrement operators have the same precedence as pointer operators, however, so combinations of pointer and increment/decrement operators can be tricky if not carefully handled. Note that each of the expressions shown in Figure 4 performs a different operation.

When reading these combinations, remember that while the unary operators such as pointer operators are read right to left, the increment and decrement operators are prefix/postfix operators. That is, if placed on the left, they operate before the variable is evaluated; if placed on the right, they operate after the variable is evaluated. Moreover, they affect the variable to their *immediate* left or right.

Thus in the first of the four assignment cases shown in Figure 4, the pointer variable pChar is the variable immediately to the left of the ++, so it is what is incremented, but only after the value pointed to by pChar is assigned to ch.

In the second example, the ++ is located immediately to the left of pChar, so it increments pChar before the value is assigned to ch. In the third assignment case, the value to the right of the ++ is not the variable pChar, but the value returned by *pChar, so that is what is incremented.

Finally, in the expression `ch= (*pChar)++;`, the parentheses must be used so that the increment operator will be applied to the *combination* of the * and pChar. Because of the higher precedence of the parentheses, the combination enclosed is evaluated before the increment operator goes to work.

Of these examples, the first combination, `*pChar++;`, is the most commonly used, since it is a convenient shorthand way to retrieve an item in an array and then point to the next item. The following classic example uses this expression to copy a string:

```
char Str1[20];
char Str2[20];

strcpy (Str2, Str1);
    .
    .
    .
void strcpy (char *pStr2, char
 *pStr1) {
  while (*pStr != 0)
    *pStr2++ = *pStr1++;
}
```

In this `strcpy` routine, the expression

```
*pStr2++ = *pStr1++;
```

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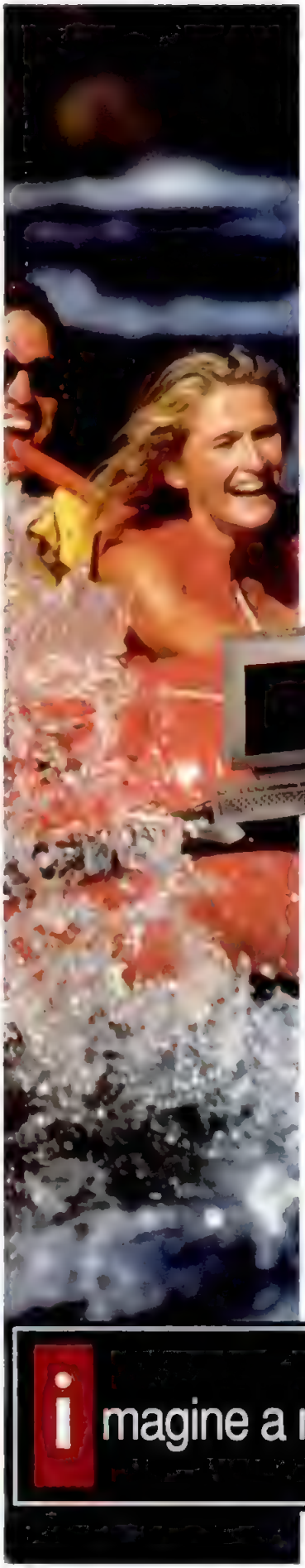

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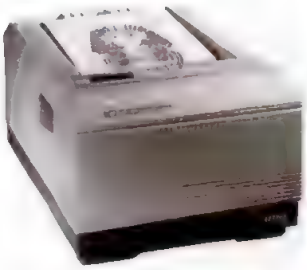

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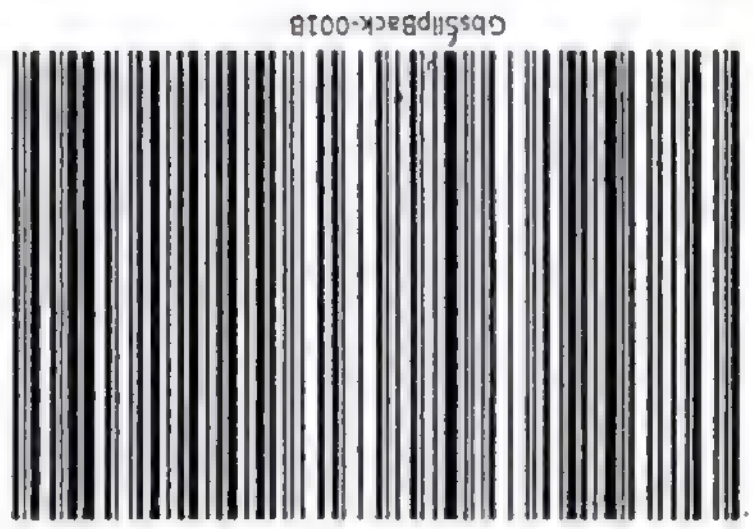

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1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

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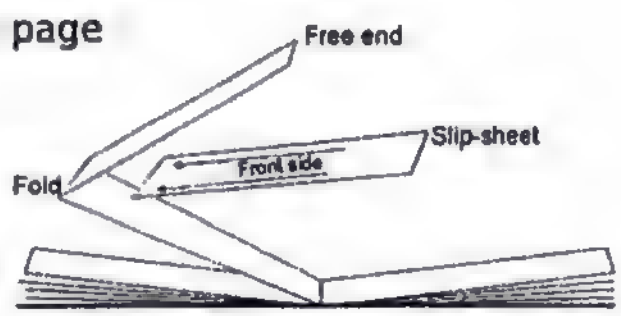

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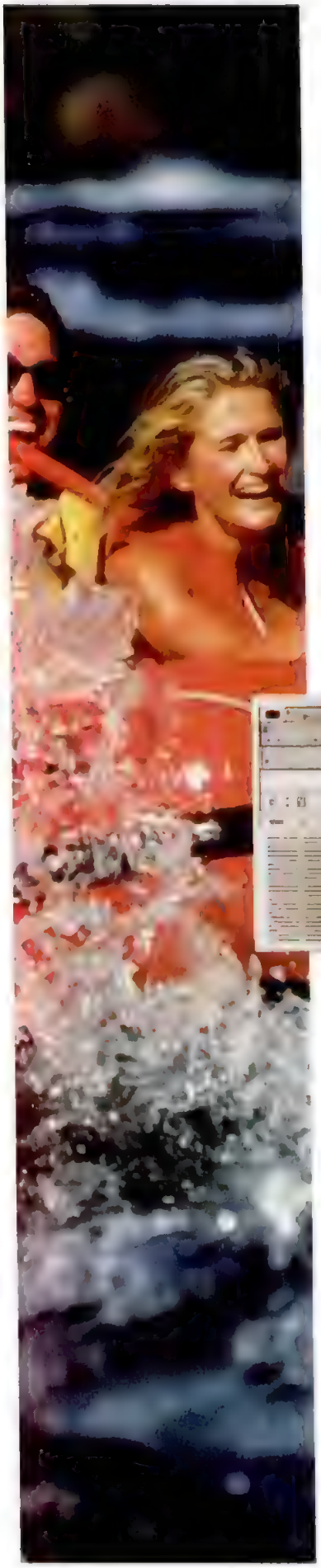

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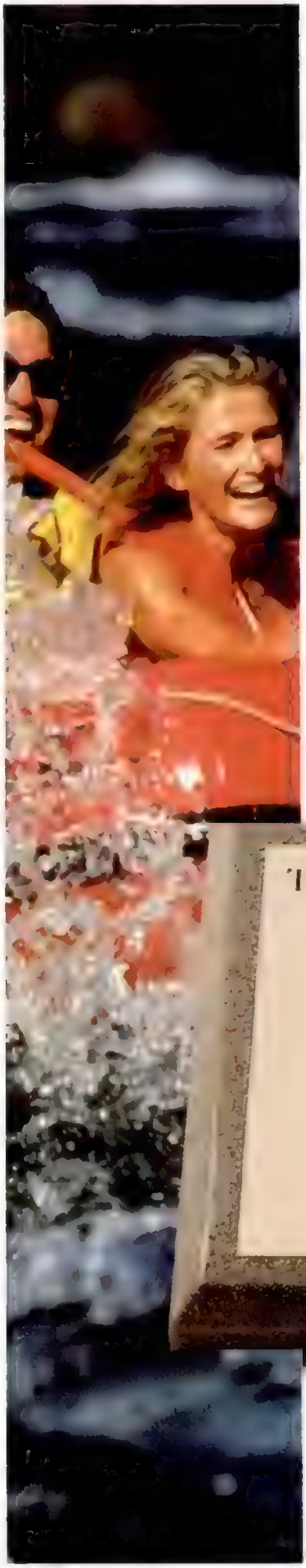

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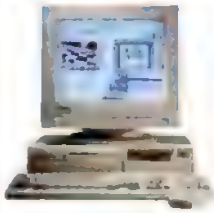	• **25MHz i486SX** **$1,349** • **33MHz i486SX** **$1,449** • **33MHz i486DX** **$1,699** • **50MHz i486DX2** **$1,899** • **66MHz i486DX2** **$2,099** • **Lease for as low as $47/Month**	• Local bus SVGA video • GUI accelerator • 4 MB RAM • 1 MB video RAM • 170 MB hard drive • 3 ISA slots • 4 drive bays	• 3.5" floppy drive • 14" SVGA(i) color monitor • Microsoft's Ready-To-Run MS-DOS 6.0/Windows 3.1 • Mouse • 101-key keyboard
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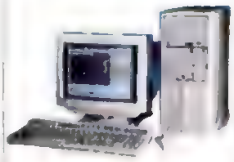	• **33MHz i486DX** **$2,924** • **66MHz i486DX2** **$3,324** • **Lease for as low as $102/Month**	• 6 EISA slots with 1 VESA-VL • Local bus SVGA video • GUI accelerator • 8 MB RAM • 128 KB cache • 1 MB video RAM • 245 MB hard drive • 5 drive bays • 3.5" floppy drive	• Pentium OverDrive Processor upgrade • 14" SVGA(i) color monitor • Video adapter • Microsoft's Ready-To-Run MS-DOS 6.0/Windows 3.1 • Mouse • 101-key keyboard
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is used to copy the value pointed to by pStr1 to the location pointed to by pStr2. It also increments the two pointers after each copy operation.

C purists may look askance at my explicit coding of `(*pStr != 0)` to test for the terminating zero of the source string. The condition could also have been written simply as `(*pStr1)`, since that will test false any time pStr1 points to a zero byte. True hackers may also condemn my multiline coding of the `strcpy` routine, which can be reduced to

```
void strcpy (char *pStr2, char
 *pStr1) {
  while (*pStr2++ = *pStr1++);
}
```

My answer is that I attempt to write code that is easy to read rather than code compressed into as few lines as possible. I feel it is the job of the compiler, not the programmer, to reduce multiline expressions to the fewest possible bytes.

POINTERS TO POINTERS Pointers can also point to other pointers. In Figure 5 I have declared an integer and two pointers: a pointer to an integer, and a pointer to an integer pointer.

In this example, the integer and pointer to the integer act as you would expect. `X = 1` simply assigns a value to X. `*pIntPtr = 2;` *also* assigns a value to X, since 2 is assigned to the memory location pointed to by pIntPtr, and I have previously pointed pIntPtr to X. The third assignment, however,

```
**ppPtr2IntPtr = 3
```

is new. This can be read as saying the address pointed to by ppPtr2IntPtr contains a pointer to an address that should be assigned the value 3.

CASTING POINTERS One potentially troublesome pointer problem arises when a pointer is *cast* to point to a different variable type. For those unfamiliar with C, *type casting* is used to tell the C compiler to treat a variable as a different type in a specific context. For example, if a char pointer is cast as an integer pointer, the C compiler is told in this specific instance to treat the pointer, originally created to point to a byte value, as a pointer to a 2-byte value (an integer).

Pointers

Sample Code

```
int X;                      /* An Integer */
int *pIntPtr;               /* An Integer pointer *
int **ppPtr2IntPtr;         /* A pointer to an integer pointer */

pIntPtr = &X;               /*pIntPtr points to X *
ppPtr2IntPtr = &pIntPtr;     *ppPtr2IntPtr now points to pIntPtr */

X = 1;                      /* Assign X a value *
*pIntPtr = 2;               /* Assign X another value using the integer
                               pointer */
**ppPtr2IntPtr = 3;         /* Assign X still another value using the pointer to
                               the integer pointer. */
```

Figure 5: **Because pointers can point to other pointers, the value of a variable can be changed by means of a pointer that points to a pointer that points to the variable.**

The type casting operator is simply the new type, enclosed in parentheses and preceding the variable, as in

```
(new type)VarOldType
```

Thus, for example, the char pointer pCharPtr would be cast as an integer pointer by preceding the name pCharPtr with (int *), thus:

```
(int *)pCharPtr
```

A problem that might arise in connection with pointer type casting can occur when a file has been read into a memory buffer and a value must be read from that buffer. In the example below, a pointer, `char *pBuff`, is declared and is set to point to the starting address of the buffer:

```
int    X, Y, Z;
char   *pBuff;
```

At offset 16 of this file is a word value that needs to be read. Now, among the following possibilities, which variable—X, Y, or Z—is assigned the correct integer value?

```
X = *pBuff + 16;
Y = *(pBuff + 16);
Z = (int) *(pBuff + 16);
```

The fact is that *none* of the variables is assigned the value correctly! X is incorrect because the pointer operator * has a higher precedence than the addition operator, which causes X to be assigned 16 plus the byte value at offset 0 in the buffer.

Y is also incorrect. The parentheses correctly fix the problem with the precedence, so *(pBuff + 16) actually returns data from offset 16 in the buffer. Unfortunately, however, the value assigned is a *byte* value instead of an integer value, because pBuff is a char pointer, not an integer pointer.

Finally, Z is incorrect because the attempted type casting only extends the byte value returned by the pointer into an integer; it does not force the pointer to return the integer located at offset 16.

So what is the correct answer? One solution would be to declare the pointer an integer pointer in the first place. While this seems to be the correct answer, a potential problem can appear if you are not vigilant. Assigning X as follows:

```
int    X;
int    *pBuff;

/* This points to offset 32 in
 the buffer!  */
X = *(pBuff+16);
```

will not work! It's important to remember that a pointer is incremented by the size of the variable it is typed to point to. In this case, X is assigned the integer value at offset 32 of the file, not 16. Of course, that problem can be fixed by substituting the following:

```
int    X;
int    *pBuff;

/* Read integer at offset 16
 in buffer. */
X = *(pBuff+8);
```

but this code may not be obvious to another programmer.

I find it clearer to use the char pointer, since the file can be considered a byte array, and then to cast the pointer properly at the place where it is used. Thus,

```
int     X;
char    *pBuff;

/* Read integer at offset 16
 in buffer. */
X = *(int *)(pBuff+16);
```

You should stop a moment and evaluate exactly what is happening here. Starting with the (pBuff+16) gives you 16 plus the base address of the buffer (the address is contained in pBuff). You then type cast this value. Normally, the C compiler would treat (pBuff + 16) as the address of a byte variable, since pBuff is a char pointer. But with the (int *) type cast, you tell the compiler that this pointer is not a byte pointer but an integer pointer. Using the * operator means that you want the value at the address of this newly type cast integer pointer. Finally, the equal sign tells the compiler to assign this integer value at the address pBuff + 16 to the variable X.

As an additional way of making the expression clearer, you can add extra parentheses to indicate the precedence explicitly:

```
/* Read integer at offset 16
 in buffer. */
X = *((int *)(pBuff+16));
```

Before leaving this example, I should point out that the expression

```
X = (int *)*(pBuff+16);
```

would be *completely* wrong. The right-to-left associativity of the type cast and pointer operators means that the byte value at offset 16 will be returned. Then, however, that value will be cast as a pointer to an integer! That's definitely not the result you want.

In summary, remember that the type cast operator and the * and & pointer operators have the same precedence. Since they also share a right-to-left associativity, a combination of type casts and pointer operators must be read from right to left. Parentheses must be used if you want to override the defaults, and they may be used simply to make the expression clearer.

POINTERS TO STRUCTURES In today's GUI programming, *structures* are frequently used to pass and return values in function calls. In Windows and OS/2, structures are declared in the massive include files that are bundled with their respective software development kits. A quick glance in a file such as WINDOWS.H or OS2DEF.H will provide numerous examples of declarations of structures and pointers to structures.

The following example, from my recent HK (hotkey) utility (*PC Magazine*, October 12, 1993), declares a simple structure data type and a pointer data type that can be used to reference the structure.

In today's GUI programming, structures are frequently used to pass and return values in function calls.

```
/* A data type defined for
 a structure. */
typedef struct {
WORD    wKey;
HWND    hwndChild;
BOOL    fRunning;
} HKENTRY;

/* A pointer data type that can
 be used to reference the HKENTRY
 structure. */

typedef HKENTRY *PHKENTRY;
```

As you can see, the pointer data type PHKENTRY is defined in the same way as any other pointer. The data type to which the pointer points is followed by the * operator, followed by the name of the pointer data type.

Elements of structures in C are accessed using the standard structure . operator, as in the following:

```
/* Declare a structure of data
 type HKENTRY */
HKENTRY hkData;
HWND handle;

handle = hkData.hwndChild;
```

A pointer can also use this type of notation, as in

```
/* Declare a structure of data
 type HKENTRY */
HKENTRY hkData;
/* Declare a pointer to an HKENTRY
 structure. */
PHKENTRY phkPtr;
HWND handle;

phkPtr = &hkData;
handle = (*phkPtr).hwndChild;
```

The parentheses here are required because the . operator is one of the few C operators that has a higher precedence than the * operator. Since this notation is rather clumsy, C provides the -> operator, which can be used for pointers that point to structures. The use of the -> operator eliminates the need for the pointer operator * and for the enclosing parentheses.

Using the -> operator, the previous example becomes

```
phkPtr = &hkData;
handle = phkPtr->hwndChild;
```

All of this is rather straightforward. It gets more interesting when you use a pointer to point to an array of structures. In the following example, an array of structures is declared, along with a pointer to those structures. An individual structure entry in the array can be accessed rather simply:

```
/* Declare an array of structures
 of type HKENTRY */
HKENTRY hkData[64];
HWND handle;

handle = hkData[20].hwndChild;
```

Similarly, a pointer could be used to point to an individual member in the array, as

Structure Pointers

Sample Code

```
typedef struct {          /*
Define a structure that contains two values Cost and
                            Value */
int Value;
int Cost;
} VALARRAY;
VALARRAY ValArray[30];  /*Create an array of 30 Cost/Value structures */
VALARRAY *pValArray;    /*Create a pointer to a Cost/Value structure */

pValArray = ValArray;  /*Point the pointer to the first element in the array*/
  while (pValArray->Cost > pValArray->Value)
chkval (&pValArray); /*Call routine with the address of the structure
                       pointer */

// If the value of the item is less than the cost, increment the pointer to
// point to the next element in the array.

void chkval (VALARRAY **pValPtr) {
   if ((*pValPtr)->Value < (*pValPtr)->Cost)
      (*pValPtr)++;
}
```

Figure 6: **This example illustrates the use of a pointer to a pointer to a structure.**

we can see in the following example:

```
/* Declare an array of structures
 of type HKENTRY */
HKENTRY hkData[64];
/* Declare a pointer to an HKENTRY
 structure */
HKENTRY *phkPtr;
HWND handle;

phkPtr = hkData;
handle = (phkPtr+20)->hwndChild;
```

The entire array can also be accessed in sequence, using such code as

```
/* Declare an array of structures
 of type HKENTRY */
HKENTRY hkData[64];
/* Declare a pointer to an HKENTRY
 structure */
HKENTRY *phkPtr;
HWND handle[64];
int i;

phkPtr = hkData;
for (i = 0; i < 64; i++) {
  handle[i] = phkPtr->hwndChild;
    phkPtr++;
}
```

In this code fragment, the pointer is first assigned to point to the first member in the array. The body of the loop then assigns the hwndChild component of each structure in the array to the handle array. This is an example of a pointer being incremented by the size of the data type to which it points. Since the size of the HKENTRY structure is 6 bytes, the expression phkPtr++ actually adds 6 to the value of phkPtr. Inexperienced C programmers might be tempted to try to increment phkPtr with something like the following:

```
/* Declare a pointer to an HKENTRY
 structure */
HKENTRY *phkPtr;
phkPtr += sizeof (HKENTRY);
 /*This is wrong! */
```

Combinations of the pointer operators and the structure operators . and -> must be handled with care. Since the structure operators have a higher precedence than the * and & operators, pointers that are elements of structures can be used without parentheses. In the following example, the structure item pInt is itself a pointer. Because the . and -> operators have a higher precedence, no enclosing parentheses are needed to reference the value pointed to by pInt.

```
/* pInt now points to integer X */
Struct.pInt = &X;
/* X = 5 */
*Struct.pInt = 5;
/* Assign a pointer to point to
 the structure */
pStruct = &Struct;
/* Use the pointer to the
 structure to assign a new value
 to X. */
*pStruct->pInt = 6;
```

Sometimes, however, a pointer to a pointer to a structure must be used. This need frequently arises when a pointer to a structure is to be modified by a function. In Figure 6, a pointer to an array of structures is passed to a routine designed to modify the pointer in a way that depends on the contents of the particular structure element in the array.

Although the example in Figure 6 is somewhat contrived, it does illustrate the proper syntax for addressing an element of a structure referenced by a pointer to the structure pointer. Notice the use of parentheses, which are necessary because the -> operator has a higher precedence than the * operator. Without the parentheses, the expression

```
*pValPtr->Cost
```

would evaluate the values pointed to by Cost, not the variable Cost itself.

POINTERS TO FUNCTIONS Pointers can point not only to variables, but to functions as well. The following line declares a pointer to a function that is passed two integer values and returns an integer:

```
/* declare a pointer to a
 function. */
int (*FuncPtr) (int, int);
```

The line above declares the function pointer FuncPtr. The pointer should be assigned the address of a function with similar parameters, or the compiler will start displaying messages warning you about the inconsistent assignment. (The messages will depend on the warning level set.) When type cast warnings appear, it's best to see whether there really is a problem or whether you simply need to type cast the variables explicitly in order to eliminate the messages. Ignoring warning messages like this can cause real trouble when the program is run, however.

In the example shown in Figure 7, the routine pointed to by FuncPtr is called with variables X and Y. The declarations of the variables are typical. The function

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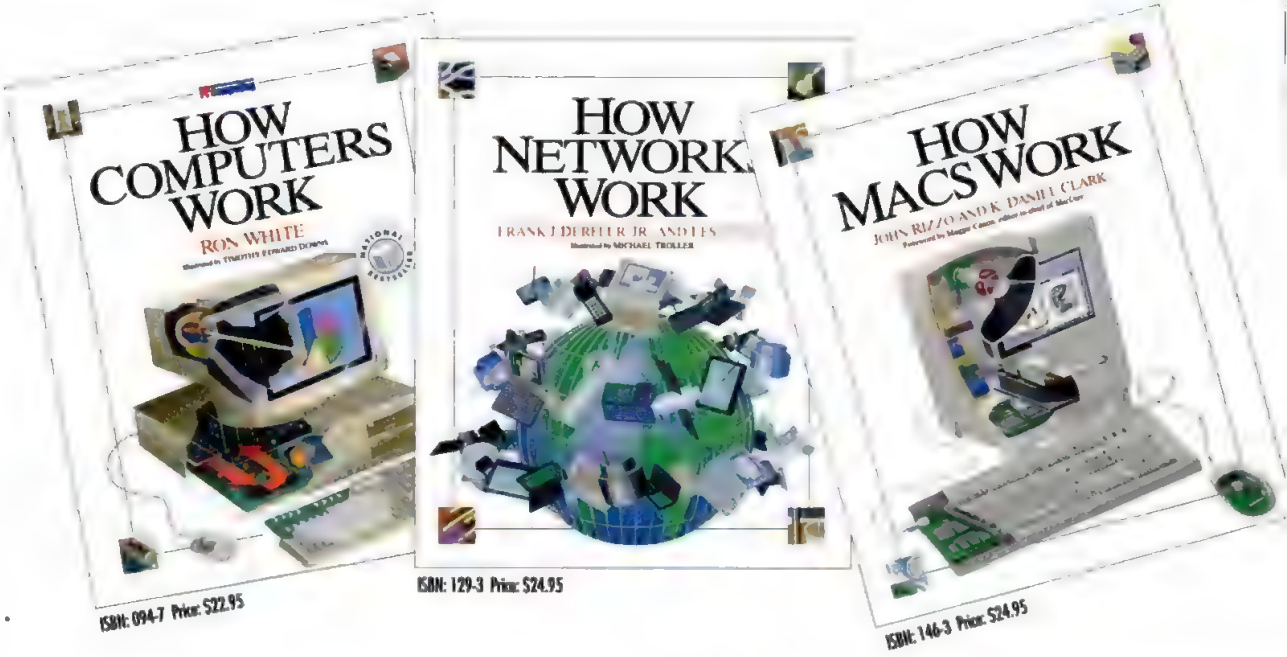

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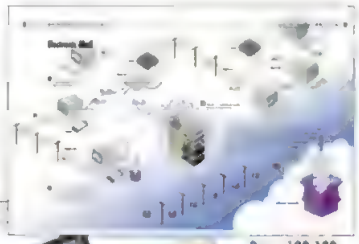

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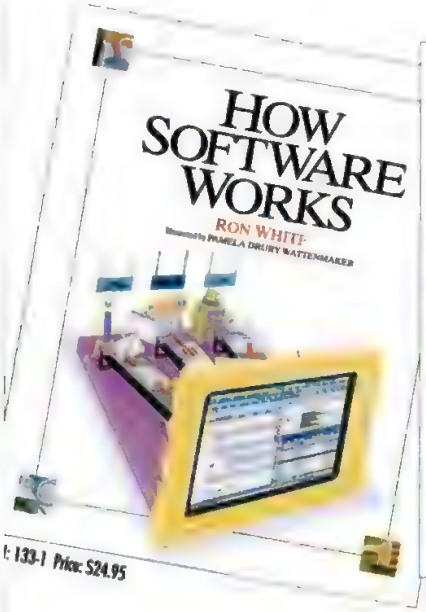

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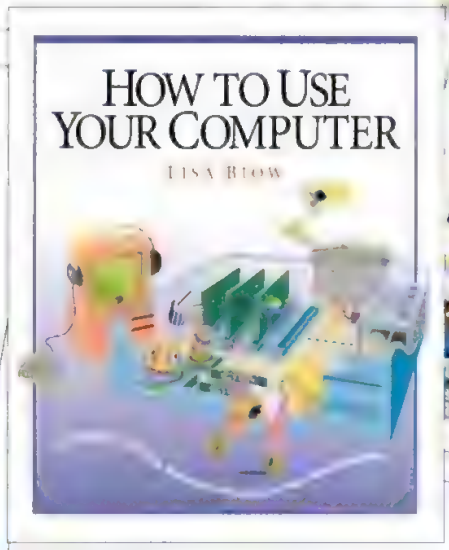

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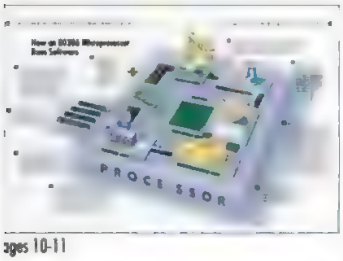

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Function Pointer

Sample Code

```
int Max (int, int);          * typical function prototype. */
int X, Y, Z;                 * typical variable declaration */
int (*FuncPtr) (int, int); /* non-typical pointer to function declaration */

FuncPtr = Max;             /* assign FuncPtr the address of Max. */

Z = (*FuncPtr) (X, Y);     /* call function (Max) pointed to by FuncPtr */
```

Figure 7: **Pointers are useful not only to point to variables, but to functions as well.**

prototype of the Max function tells the compiler which arguments the Max function requires. The assignment `FuncPtr = Max` assigns the address of Max to the variable FuncPtr. (I have omitted the body of the Max function, which is irrelevant in this example.) The address operator & is not required, for the C compiler is smart enough to determine that Max is a function, not a variable.

Calling a function pointed to by a pointer is straightforward: Simply enclose the pointer variable and a preceding * operator in parentheses, followed by the arguments to the function.

NEAR VS. FAR POINTERS So far I've been able to avoid that bane of PC programmers, the segmented memory architecture of the Intel processors. Unfortunately, however, the segment-offset design reaches into even high-level languages such as C, and pointers are the component affected. The fundamental problem is that the processors designed for 16-bit operating systems, such as DOS and OS/2 1.*x*, don't have registers large enough to reference all memory in the machines.

Without getting bogged down in details, Intel's solution was to add "segment registers," which are used to select a portion of memory to reference. The standard registers can then be used to reference memory within the confines of a particular segment.

C pointers under DOS, Windows, and OS/2 1.*x* are defined as either *near* or *far*. A near pointer is a simple, 16-bit pointer that matches the size of registers in Intel processors. Like those 16-bit registers, however, near pointers are limited to offsets between 0 and 65535. With today's machines sporting megabytes of memory, however, it's easy to see the problem with near pointers. But though not very useful for global memory access, near pointers do work well for most data accesses within typical small C programs.

Far pointers combine a 16-bit segment value that references a section of memory with a 16-bit pointer value that references the memory inside the section. Unlike near pointers, far pointers can access all of a machine's memory.

Unfortunately, however, this accessibility does come at a price. Segments, which make up the upper 16 bits of a far pointer, are not simple registers that can be manipulated by ordinary addition and subtraction. In fact, a segment under Windows or OS/2 does not actually point to a section of memory, but rather to a table of structures. These memory structures contain the base address that is added to the offset in the far pointer to get the actual memory address. As you can perhaps imagine, dealing with far pointers can be a difficult task.

32-bit operating systems eliminate the need for near and far pointer designations; since they can address all of memory directly, all pointers become near pointers.

Even given their ability to point anywhere in memory, far pointers are still limited in how much memory they can access. The problem lies in the segment portion of the far pointer. Since (in protected mode) segment values are not actual memory addresses, they can't be changed by simple addition or subtraction of the segment value. What this means is that far pointers are limited to accessing 64K of data, although that 64K can reside anywhere in memory.

To manipulate large amounts of data, programmers must resort to a third, *huge* pointer. Huge pointers are like far pointers in that they have to combine a segment with an offset value to make a 32-bit pointer. The difference is that when a huge pointer is changed, the C compiler adds extra code to the executable to ensure that the result of an add or subtract operation *will* correctly modify the segment portion of the pointer. Huge pointers, with some limitations, allow C programs on the PC to manipulate very large amounts of data.

The huge pointer is not without its problems, however. Because of the extra overhead involved in ensuring that the pointer points to the proper segment, the amount of code and processor time necessary to handle huge segments is also very large. For example, to increment a far pointer, a compiler may generate one 3-byte instruction. Incrementing a huge pointer, on the other hand, may generate 12 bytes of code. While one increment operation is not going to explode your program, it is apparent that the fourfold increase in overhead for a simple increment can cause the frugal programmer to hesitate.

Huge pointers are also limited in the variables to which they can point. Specifically, the size of the variables must be a power of 2 (1, 2, 4, 8, 16, and so on) in order to prevent a variable from being split between two segments. So while huge pointers are handy for large arrays, they must be used with caution.

32-bit operating systems such as OS/2 2.*x* and Windows NT eliminate the need for near and far pointer designations. Since the registers in the 80386 and later Intel processors are 32 bits wide, they can address all of the address space available to the processors. This makes all pointers near, in the sense that they do not include a segment register value in the pointer.

Pointers are a powerful aspect of C. With a little practice, their vast and varied uses can add power and speed to any program. So give pointers a try; you might even discover you enjoy them. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR TO *PC MAGAZINE*.

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BY NEIL J. RUBENKING

Do you tend to forget phone numbers? Can you remember 1-800-COLLECT more easily than 1-800-265-5328? If so, you'll want this issue's free utility, FONEWORD.

FONEWORD is a Windows 3.1 utility that finds all the mnemonic words and phrases that can be made from ordinary seven-digit telephone numbers. It gives you three different sets of possibilities, ranging from perfect "vanity numbers" (BIG SHOT), which consist of nothing but actual words, to word-plus-number combinations (8 DOLLAR), to a list of all the letter combinations that correspond to a given phone number. While many telephone numbers yield no useful mnemonics, it's surprising how many do.

DOWNLOADING AND INSTALLATION FONEWORD is written in Microsoft Visual Basic 3.0, and it uses both the library file VBRUN300.DLL and a number of .VBX custom control files. Because it uses VB 3's built-in database functions, it also requires several additional DLLs for database support.

Because some readers will already have Visual Basic installed on their systems and others will not, FONEWORD is available in two versions. Either can be obtained by following the instructions in the sidebar "How to Get *PC Magazine*'s Utilities." If you want to modify portions of the source code, you'll need Visual Basic Professional Edition, Version 3.0. (The regular edition lacks some of the custom controls.)

If you already have VB Professional Edition 3.0 installed, you need only the file FONESM.ZIP. Simply download it, unzip it into a subdirectory on your hard disk, and create a program item (icon) for it in Program Manager. Otherwise, download the file FONED1.ZIP, unzip it to a floppy disk or a subdirectory, and run the SETUP program you'll find on that disk or directory. This SETUP program was created by the Setup Wizard application that comes with Visual Basic. It installs the necessary support files if they're not present and updates them if they're present but out of date.

USING FONEWORD Figure 1 shows FONEWORD's main screen, with its text box, three list boxes, and their associated controls. To use FONEWORD, simply type a phone number (numeric input only, up to seven digits) into the text box at top center and press the button labeled "Only words" at the top of the left list box. FONEWORD will consult its database and attempt to find combinations of words that utilize all of the digits in the number.

Here's an easy way to remember phone numbers: Turn them into words with this Windows 3.1 utility, written in Visual Basic.

Some telephone numbers generate no items for this list, while others produce dozens. Of course, it's up to you to decide among PIN-DROP, SHOE-POP, SIN-EROS, and a host of others. (I did not purge the dictionary of all the terms some people might find offensive.) Since the digits 0 and 1 have no letter representations, they are treated as words in their own rights and so yield combinations such as NUMBER 1.

If the "Only words" list produces no suitable vanity numbers, press the "Real words" button above the middle list box. Entries in the middle list need contain only one real word of two letters or more. Each entry displays the real word set off by spaces from any unconverted numbers, such as 7 COME 11.

To list all possible combinations of letters derivable from the phone number you entered, press the "All words" button above the right list box. With three possible letters for each digit, a full seven-digit phone number will yield 3^7 (2,187) different letter combinations. The digits 0 and 1 don't correspond to any letters, so if the number contains any 0s or 1s, there will be fewer combinations. If you're willing to accept a vanity number with words misspelled, for example, KATT-INN for a kennel, you may be able to find one by scrutinizing this list.

Database lookups are relatively slow operations, so filling the list boxes can take a few minutes. Immediately to the left of each list box is a gray bar that gives a visual indication of how much processing is left to do. If you want to halt a lookup before completion, just press the

Top 10 DOS Utilities

Rank	Utility
1	**DIRMATCH** - *Compares directories*
2	**BAT2EXEC** - *Compiles batch files*
3	**DEFRAGR**- *Defragments disks*
4	**CHKFRAG** - *Checks fragmentation*
5	**PCSPOOL** - *Print spooler*
6	**STRINGS** - *Batch file versatility*
7	**PCUNZP** - *Unzips files*
8	**PCREM2** - *Remotely operates computer*
9	**CDX** - *Changes directories*
10	**BOOT2C** - *Forces hard disk boot*

This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "How to get PC Magazine*'s Utilities."*

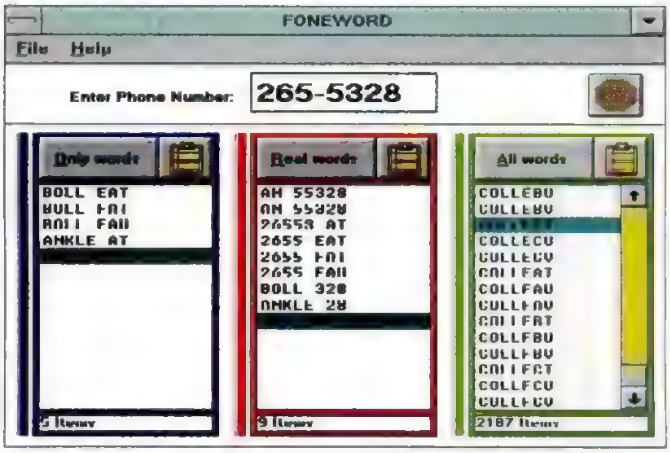

Figure 1: **FONEWORD helps you find mnemonic phrases for phone numbers.**

STOP sign in the upper-right corner. (You'll notice that the sign is normally dimmed; it brightens and becomes active only during the processing of one of the list boxes.)

When you've filled one or more of the lists, you can highlight and copy the selected item(s) to the Clipboard so they can be written to a text file or incorporated into another document. The list boxes in FONEWORD work just like the file lists in File Manager: To select a range of items, click on the first, then hold Shift down as you click on the last; to select or deselect an individual item without affecting other items, press Ctrl as you click on it. When you've highlighted all of your choices, press the Clipboard button at the top of the list to copy them to the Clipboard.

That's all you need to know to use FONEWORD! Should you need help while using the program, just select an item from the help menu. For help with using a particular on-screen element, tab to that element and press the F1 key.

PROGRAMMING FONEWORD Visual Basic makes database programming amazingly easy. It takes just two lines of VB 3.0 code to open a database; another two lines check whether a given field value exists. I chose to store FONEWORD's internal database in Paradox format because my informal experimentation showed that this produced the smallest database file for the word list. But I could have used any format that Visual Basic supports.

FONEWORD also uses a number of the special controls from VB's Professional Edition. Specifically, the phone number text box is a Masked Edit control; the three completion gauges are Gauge controls; and the four buttons with pictures are graphical Push buttons.

Generating a list of all possible letter combinations is a simple exercise in recursion—a topic that I'll discuss a little later. Finding which combinations contain real words is the challenge. A phone number can contain any word of up to seven letters that has no Q or Z in it. Fortunately, years ago I compiled an exhaustive word list for my NAMEGRAM anagram generator. FONEWORD's internal dictionary is a subset of that list.

In my first crack at programming FONEWORD, I simply imported the word list directly into the Paradox database FONENUMS.DB so that it contained a single 7-letter text field that also served as the primary index. I took each of the up-to-2,187 combinations of letters and checked whether each of its substrings was a word. A 7-letter text string has one 7-letter substring, two 6-letter substrings, and so on, for a total of 28 substrings. With 2,187 combinations times 28 substrings each, the program might have to perform over 60,000 database lookups! As a result, its performance was utterly abysmal—too slow for anyone to actually use.

In fact, however, most of those 60,000 database lookups were redundant. There are actually only 4,098 distinct words. Where does that number come from? Multiplying 3 possible letters for the first digit times 3 for the second digit and so on, we see that the number of possible words formed by a string of n digits is 3 to the n power. Thus, the one 7-letter substring forms 3^7 possible words; the two 6-letter substrings each form 3^6 possible words, and so on, for a total of 4,098. My original algorithm had been looking up most of the possible words many times. For example, in processing the number 265-5328, it looked up "AMJJD" as a substring of nine different strings, ranging from "AMJJDAT" to "AMJJDCV." My second algorithm carefully avoided looking up any word more than once. It was better—but it was still impractically slow.

I found that the solution to improving FONEWORD's performance was to look at the problem from a completely different angle. As a result, the current database doesn't contain words at all! In place of each word, the database stores the string of digits that you would get by typing the word on your telephone, together with an integer that encodes instructions for deriving the original word from the digit string. Using this as the database, it's necessary to look up only the 28 substrings of the original phone number. That's quite an improvement—going from over 60,000 database lookups to under 100.

FONEWORD'S SECRET CODE Although they are stored as decimal integers, the integer codes stored in FONEWORD's database are actually numbers in base 3. A single digit in base 3 can have the value 0, 1, or 2. If it's 0, the corresponding digit in the phone number string is replaced by the first possible letter for that digit. If it's 1, the second possible letter is used; if it's 2, the third. To decode a digit string, therefore, FONEWORD repeatedly divides the decimal code number by 3 and uses the remainder to determine which letter to use.

The table in Figure 2 shows the actual process of decoding the string "2222537," using the code 1900 (2121101 in base 3). The first remainder is 1, so we replace the first character with the second of the three possible letters. The second re-

Decoding Digits

String	Code	Quotient	Remainder
2222537	1900	633	1
B222537	633	211	0
BA22537	211	70	1
BAB2537	70	23	1
BABB537	23	7	2
BABBL37	7	2	1
BABBLE7	2	0	2
BABBLES	0		

Figure 2: **An entry in FONEWORD's database includes a string of digits and a code that is used to convert the string into a word.**

mainder is 0, so we replace the second character with the first of the possible letters. This continues until the string is completely decoded. Figure 3 shows the Visual Basic function Decode$, which implements the process described here.

There's one hitch in this scheme: A given string of digits may well decode to more than one word. Indeed, from the user's point of view this is highly desirable. For example, the string "22737" has 12 possible interpretations, including ACRES, BASES, and CAPER. In this case, therefore, the database should have 12 entries in which the key is 22737, each with a different code. Like many database systems, however, Paradox does not permit duplicates in the primary key. Eliminating the key is not an option because doing so would render database lookups impossibly slow.

FONEWORD solves this dilemma by appending the letters A, B, C, and so on to successive key entries for the same digit string. Thus the second entry for "22737" is "22737A," the third "22737B," and so on. Other solutions may be more elegant, but this technique is economical in terms of database size.

The function NextMatch$, shown in Figure 4, can be called repeatedly to return each entry that matches a given digit string. Its second parameter is a one-character string, *C*, which the calling function must set initially to @. (The ASCII code for the @ character comes just before A.) Each call to NextMatch advances *C* to the next character. NextMatch returns the decoded word, or an empty string if there was no match. It also includes logic to handle one-character digit strings without accessing the database.

Figure 5 lists the subroutine FindRealWords, which uses NextMatch to find real words within the input phone number. FindRealWords simply looks up each of the 28 possible substrings and reports any word matches by replacing the substring with the corresponding word, set off by spaces. With the support functions NextMatch$ and Decode$ in place, FindRealWords is remarkably simple!

RECURSION IN FONEWORD Sooner or later every programmer must grapple with the concept of recursion. A recursive procedure or function is one that calls itself. The factorial function is often used as an example of recursion. The factorial of a positive number *n* is defined as the product of all numbers from *n* down to 1. A recursive definition of this function might thus be "The factorial of 1 or 0 is 1. For any other positive value *n*, the factorial is *n* times the factorial of *n*-1." Note that the definition includes a provision for the recursion process to end; in this case, the process finishes

DECODE.BAS

Complete Listing

```
Function Decode$ (ByVal S$, ByVal Code%)
  ' This function receives a string of digits from 2 to 9
  ' and an integer that tells how to decode those digits
  ' into a real word. It repeatedly divides the code by
  ' 3 and uses the remainder as an index into the A array,
  ' selecting the first, second, or third letter associated
  ' with the current digit.
  Dim N%, TempS$
  If (Len(S) = 1) And InStr("01", S) Then
    Decode = S
  Else
    TempS = NullStr
    For N = 1 To Len(S)
      TempS = TempS + A(Asc(Mid$(S, N, 1)), Code Mod 3)
      Code = Code \ 3
    Next N
    Decode = TempS
  End If
End Function
```

Figure 3: **The Decode$ function takes a digit string and converts it into a word by repeatedly dividing a code by 3 to get the base 3 number it represents.**

NEXTMATC.BAS

Complete Listing

```
Function NextMatch$ (ByVal S$, C$)
  ' Called by FindRealWords and OnlyRealWords
  '
  ' Handles the fact that multiple decodings of the same
  ' string of digits exist. The first is keyed with the
  ' digit string itself, and the later ones have A, B,
  ' C, and so on appended in turn.
  Dim Criteria$, Code%
  NextMatch = NullStr
  If C = "?" Then Exit Function
  If Len(S) = 1 Then
    ' deal with single-digit "words" w/o hitting database
    Select Case S
      Case "0", "1"
        NextMatch = S
      Case "2"
        NextMatch = "A"
      Case "4"
        NextMatch = "I"
      Case "^"
        NextMatch = "O"
    End Select
    C = "?"
  Else
    If C = "@" Then
      Criteria = "Foneword = '" + S + "'"
    Else
      Criteria = "Foneword = '" + S + C + "'"
    End If
    MySet.FindFirst Criteria
    If Not MySet.NoMatch Then
      Code = MySet("Code")
      NextMatch = Decode(S, Code)
    End If
    C = Chr$(Asc(C) + 1)
  End If
End Function
```

Figure 4: **The NextMatch$ function checks the database for entries matching the input string, returning either the next matching word or a null string.**

when *n* gets down to 1. Every recursive function must provide such an outlet.

Unlike some early versions of BASIC, VB 3.0 supports recursion, and FONEWORD depends on that to fill the "All words" and "Only words" list boxes. The function AllCombos, listed in Figure 6, takes a string of digits and generates all possible combinations of letters, inserting the results in the list box named ListAll. Its first parameter, *S*, is the string being worked on, and its *N* parameter is the current character position. If *N* is beyond the end of the string, the AllCombos function adds the completed string to the list box. Otherwise, for each of the three possible letters corresponding to the *N*th digit, AllCombos replaces the digit with that letter and passes the modified string back to itself, adding 1 to the value of *N* in order to process the next digit.

It may be instructive to trace the operation of AllCombos on the partial phone number "28." Initially, *S* is 28 and *N* is 1. AllCombos replaces the first digit (2) with the letter A and calls itself again. This second instance of AllCombos receives the parameters A8 and 2, and in its turn, it replaces the second digit (8) with the letter T and calls itself again. This time the parameters are AT and 3. Since 3 is greater than the string's length, AllCombos adds "AT" to the list box and returns.

The second instance of AllCombos now calls itself twice more, passing "AU" and then "AV" with the character position 3. After that it returns to the first instance, which has remained in memory. The first instance now calls itself, passing "B8" and the position 2. By the time this series of calls finishes, all nine possible combinations are in the list box.

The function OnlyRealWords, shown in Figure 7, uses a somewhat different type of recursion to find all "vanity numbers," that is, solutions that use all the

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NO MODEM, NO PROBLEM If you don't have a modem, you can still get FONEWORD without charge directly from *PC Magazine*. Just send a postcard with your name, address, and disk-size preference (1.2MB or 1.44MB) to the attention of Katherine West, *PC Magazine*, One Park Ave., New York, NY 10016-5802. As an alternative, you can fax your request to 212-503-5799. No phone calls please.

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FINDREAL.BAS

Complete Listing

```
Sub FindRealWords ()
  ' Called when you press the CommandReal button.
  '
  ' Considers every substring of the phone number that's
  ' at least MinWord in length. If it's in the database,
  ' decodes it into a word and adds the result to the list.
  ' Then it checks for other words made from the same
  ' digits. The key values for these other words will
  ' be the same as the original number with A, B, C
  ' and so on appended in turn.
  Dim Start%, Num%, vLen%, Code%
  Dim S$, SPart$, SDecode$
  Dim Char As String * 1
  vLen = Len(PhoneEdit.ClipText)
  GaugeReal.Max = 1
  For Num = MinWord To vLen
    For Start = 1 To (vLen + 1 - Num)
      GaugeReal.Max = GaugeReal.Max + 1
    Next Start
  Next Num
  GaugeReal.Value = 0
  For Num = MinWord To vLen
    For Start = 1 To (vLen + 1 - Num)
      GaugeReal.Value = GaugeReal.Value + 1
      DoEvents
      If Not Continue Then Exit Sub
      SPart = Mid$(PhoneEdit.ClipText, Start, Num)
      Char = "0"
      SDecode = NextMatch(SPart, Char)
      Do While Len(SDecode) <> 0
        DoEvents
        If Not Continue Then Exit Sub
        S = NullStr
        If Start > 1 Then S = Mid$(PhoneEdit.ClipText, 1, Start - 1) + " "
        S = S + SDecode
        If Start + Num <= vLen Then S = S + " " + Mid$(PhoneEdit.ClipText,
 Start + Num)
        ListReal.AddItem S
        SDecode = NextMatch(SPart, Char)
      Loop
    Next Start
  Next Num
  GaugeReal.Value = GaugeReal.Value + 1
End Sub
```

Figure 5: **FindRealWords repeatedly calls NextMatch$ (Figure 4) to identify real words and then lists all real words found within the input phone number.**

digits of the phone number. The function takes two parameters, the input string *S* and an initially empty accumulator string *SAcc*. OnlyRealWords defines a vanity number as one that can either be represented by a single real word or one that can be divided into two vanity numbers. Using this recursive definition handles breaking down the original string into any number of substrings. It would, for example, translate the number 242-4242 into "A I A I A I A."

OnlyRealWords starts by seeing whether string *S* begins with a real word of any length from 1 character up to the entire string. For each real word found, it calls itself, passing the remainder of the input string as the first parameter and appending the found word to the accumulator string in the second parameter. If it manages to convert all the digits of the input string, it combines the accumulator with the most recently found word and adds the result to the list box. By using recursion, this function avoids spelling out every possible partition of the input string into one- and six-letter substrings, two- and five-letter substrings, and so on.

FONEWORD relies on Visual Basic's built-in Clipboard object to move text from a list box to the Clipboard. Each list box has an associated push button with a picture of the Clipboard on it. Pressing one of these buttons calls the procedure ToClip, shown in Figure 8, passing the associated list box as a parameter. From the list box, ToClip builds a text string that contains each selected item, separated by carriage return and line-feed. It takes only one line of code to clear the contents of the Clipboard and just one more line to copy the built-up text string into the Clipboard!

DEALING WITH LENGTHY ROUTINES Because Windows is not a preemptive multitasking system, any program can temporarily slow Windows to a dead stop simply by performing a lengthy task without giving Windows a chance to process messages. Database lookups are often such lengthy tasks, during which Windows won't respond to messages. In some languages, the programmer must write a construct called a PeekMessage loop, which calls several Windows API functions, just to avoid bringing Windows to its knees. In Visual Basic, however, the

ALLCOMBO.BAS

Complete Listing

```
Sub AllCombos (ByVal S$, ByVal N%)
  ' Called when button CommandAll is clicked
  '
  ' Recursive function. Replaces the Nth digit of S with
  ' each of the three possible letters, then calls itself
  ' to handle the N+1th digit for each. When it passes
  ' the LAST digit, it records the completed combination
  ' by adding it to a list box.
  '
  Dim Ch%
  DoEvents
  If Not Continue Then Exit Sub
  If N > Len(S) Then
    ListAll.AddItem S
    GaugeAll.Value = ListAll.ListCount
  Else
    Ch = Asc(Mid$(S, N, 1))
    If (Ch >= 50) And (Ch <= 57) Then
      Mid$(S, N, 1) = A(Ch, 0)
      AllCombos S, N + 1
      Mid$(S, N, 1) = A(Ch, 1)
      AllCombos S, N + 1
      Mid$(S, N, 1) = A(Ch, 2)
      AllCombos S, N + 1
    Else
      AllCombos S, N + 1
    End If
  End If
End Sub
```

Figure 6: **The recursive function AllCombos calls itself repeatedly to generate all possible combinations of letters found in a given phone number.**

ONLYREAL.BAS

Complete Listing

```
Sub OnlyRealWords (ByVal S$, ByVal SAcc$)
  ' Called when you press the CommandOnly button
  '
  ' Checks each prefix of the passed string to see if it's
  ' a word. If so, adds the decoded word to the accumulator
  ' string SAcc and calls itself recursively to handle the
  ' remainder of the string. Only if the string is entirely
  ' converted to words does it add the result to the list.
  Dim N%, SPart$, SDecode$
  Dim Char As String * 1
  If Not Continue Then Exit Sub
  For N = 1 To Len(S)
    ' Only advance the gauge for the first instance
    If Len(SAcc) = 0 Then GaugeOnly.Value = GaugeOnly.Value + 1
    DoEvents
    If Not Continue Then Exit Sub
    SPart = Mid$(S, 1, N)
    Char = "0"
    SDecode = NextMatch(SPart, Char)
    Do While Len(SDecode) <> 0
      DoEvents
      If Not Continue Then Exit Sub
      If N = Len(S) Then
        ListOnly.AddItem Mid$(SAcc + " " + SDecode, 2)
      Else
        OnlyRealWords Mid$(S, N + 1), SAcc + " " + Left$(SDecode, N)
      End If
      SDecode = NextMatch(SPart, Char)
    Loop
  Next N
  ' Only advance the gauge for the first instance
  If Len(SAcc) = 0 Then GaugeOnly.Value = GaugeOnly.Value + 1
End Sub
```

Figure 7: **The OnlyRealWords subroutine locates combinations of words that completely replace the digits of the original phone number.**

problem is handled by the built-in DoEvents command. The routines AllCombos, FindRealWords, and OnlyRealWords all include one or more calls to DoEvents. DoEvents calls come between other statements, and each database lookup is accomplished by a single statement, so you'll notice that Windows won't respond to messages during a database lookup.

If a process takes more than a few seconds, a courteous program will let the user know how the task is progressing. Each of FONEWORD's list boxes is associated with a Gauge control—a control that fills up with color to show how much of the task is complete. Of course, it's up to the programmer to define what "complete" means, by setting the gauge's Max field to a value that indicates the task has been completed.

AllCombos can calculate in advance how many items will be added: It simply raises the gauge by one unit for each item added. FindRealWords calculates the number of substrings it must process and advances the gauge each time it finishes one substring. Since the amount of time spent on a given substring will vary, this gauge doesn't advance smoothly. There's no way for OnlyRealWords to evaluate the number of recursive calls it will make, so it moves the gauge once for each substring length from 1 to the original string's length.

The user can now see whether a process is half-done, nearly done, or barely started. If time is short, the user may want to stop the lengthy routine before it finishes. In FONEWORD, pressing the STOP button at the upper right stops the current routines. Pressing this button sets a global variable called Continue to FALSE, and each of the three routines terminates when Continue becomes FALSE. The STOP button is dimmed when a lengthy process is not occurring.

The short Before and After Subroutines listed in Figure 9 are called to set up each of the three lengthy processes and to clean up afterward. The Before routine clears the appropriate list box and its item-count line. It sets Continue to true, changes the mouse pointer to an hourglass, and sets the STOP button's picture fields to a bright red-and-white stop-sign image. The After routine dims the STOP button, restores the default mouse pointer, and reports the item count. The call to MessageBeep, a Windows API function declared in FONEWORD's declarations section, either beeps the speaker or causes Windows to play the default .WAV sound file. Note that this beep will sound even if FONEWORD is minimized.

HELP IN FONEWORD Visual Basic controls have a property called HelpContext ID. If you associate a help file with your program in the Options | Project dialog, pressing F1 will bring up the help screen associated with the HelpContextID of whatever control has the focus. This makes adding context-sensitive help to a VB application a snap. I used the Windows Help Magician from Software Interphase to create FONEWORD's help file. The package's visual orientation makes it much easier to use than the traditional combination of Word for Windows and the Windows Help Compiler.

TOCLIP.BAS

Complete Listing

```
Sub ToClip (L As ListBox)
  ' Called when you press one of the clipboard buttons
  '
  ' Copies the selected items from the associated list
  ' box to the clipboard.
  Dim N%, Text$
  Text = NullStr
  If L.ListCount = 0 Then Exit Sub
  For N = 0 To L.ListCount - 1
    If L.Selected(N) Then
      Text = Text + L.List(N)
      Text = Text + Chr$(13) + Chr$(10)
    End If
  Next N
  If Len(Text) = 0 Then
    MsgBox "No items are selected", 0
  Else
    Clipboard.Clear
    Clipboard.SetText Text
  End If
End Sub
```

Figure 8: **Visual Basic's Clipboard object makes it easy for this routine to copy selected items from a list box to the Windows Clipboard.**

BEFORAFT.BAS

Complete Listing

```
Sub Before (Lis As ListBox, Lab As Label)
  Continue = True
  Lis.Clear
  Lab.Caption = NullStr
  Form1.MousePointer = 11
  PushStop.PictureUp = ImageStopUp.Picture
  PushStop.PictureDown = ImageStopDn.Picture
End Sub
Sub After (Lis As ListBox, Lab As Label)
  PushStop.PictureUp = ImageDiStopUp.Picture
  PushStop.PictureDown = ImageDiStopDn.Picture
  Form1.MousePointer = 0
  Lab.Caption = Lis.ListCount + " Items"
  MessageBeep (0)
End Sub
```

Figure 9: **Since FONEWORD's search routines can take several minutes, the routines Before and After set up for lengthy processing and clean up afterward.**

HELPMENU.BAS

Complete Listing

```
Sub HelpMenu_Click (Index As Integer)
  ' Note that WinHelp and WinHelpByNum are declared in
  ' the declarations section, to give this VB program
  ' access to the Windows API function WinHelp.
  Dim Success%
  Select Case Index
    Case 101
      Success = WinHelpByNum(Form1.hWnd, App.HelpFile, HELP_CONTENTS, 0)
    Case 102
      Success = WinHelp(Form1.hWnd, App.HelpFile, HELP_PARTIALKEY, "")
    Case 103
      Success = WinHelpByNum(Form1.hWnd, App.HelpFile, HELP_HELPONHELP, 0)
    Case 105
      Form2.Show
  End Select
End Sub
```

Figure 10: **FONEWORD's Help menu choices rely on the Windows API function WinHelp to process the standard Windows Help menu choices.**

The standard, Microsoft-defined Help menu includes items that show the help file's contents page, bring up the Search dialog box, display help on using Help, and present an About dialog box. Visual Basic does not directly support the first three of these options, so FONEWORD uses the Windows API function WinHelp, which is defined in its declarations section. As Figure 10 shows, WinHelp handles all three of the necessary tasks. Of course, the About FONEWORD dialog box is simply a second form in the same program.

PAYING THE PIPER In almost any other language, FONEWORD would have been a much bigger program. Code to handle its user interface and database would have to be designed, developed, and debugged. By contrast, database access in Visual Basic is completely handled by support DLLs, and the programmer needs to write only the highest-level code to create the user interface out of standard elements.

This simplicity comes at a price, however. The database support files for Visual Basic programs require just short of a megabyte of disk space. You'll incur that cost the first time you install any VB program that uses database functions. Any subsequent VB database programs won't add to that load, though. And since the VB programs are quite small, if you run a lot of them, this system of shared resources will ultimately mean a savings in hard disk space. And if FONEWORD is your first such VB application, I'm sure it won't be your last! □

NEIL J. RUBENKING IS TECHNICAL EDITOR OF *PC MAGAZINE*.

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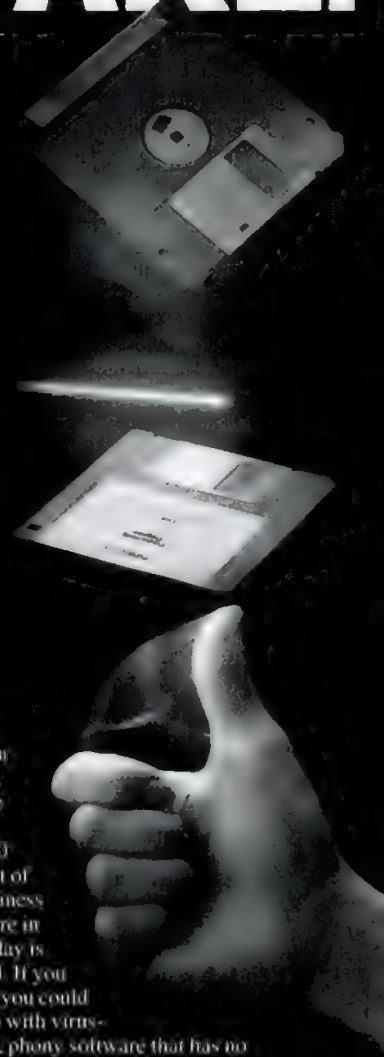

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Move Over, ASCII! Unicode Is Here

BY CHARLES PETZOLD

A great concept deserves a great name, and that name is *Unicode.*

Say it to yourself a few times. Get used to it. The prefix *uni* is from the Latin word for *one,* and the word *code* (as defined in sense 3a in *The American Heritage Dictionary*) is "A system of signals used to represent letters or numbers in transmitting messages."

Say it again: *Unicode.* How hip and mellifluous the word is, particularly when compared with ASCII (pronounced ASS-key), EBCDIC (EB-see-dik), or even Baudot (baw-DOE). These comparisons are quite valid, for the goal of Unicode is nothing less than to dislodge and replace what is perhaps the most dominant standard in personal computing—the American Standard Code for Information Interchange.

Ambitious? Of course. But Unicode makes so much sense, it seems inevitable. Check out some of the companies that collaborated in The Unicode Consortium to bring Unicode about: IBM, Microsoft, Apple, Xerox, Sun, Digital, Novell, Adobe, NeXT, Lotus, and WordPerfect.

With the release of Windows NT, Unicode has become not just a proposed standard, but a reality, and in the next couple of issues we'll take a look at that reality. Let's begin, however, with a historical perspective, and why Unicode is so important to the future of computing.

CODING LANGUAGE Human beings differ from other species in their comparatively high level of communication and the development of spoken language. The need to record spoken language led to writing, which makes it possible to preserve and convey knowledge and experience. Computers and other digital systems work entirely with numbers, so to represent text in our computers, it is necessary to create an equivalence between numbers and characters.

Until the invention of the telegraph by Samuel Morse in the mid-1800s, long-distance communication required letters to be transported by person, horse, or train. The telegraph made long-distance communication nearly instantaneous by transmitting a series of electrical pulses through a wire. But what do electrical pulses have to do with language? The telegraph required that a code be devised correlating each letter in the alphabet with a particular series of short and long pulses (*dots* and *dashes*) that sounded like clicks on the receiving end.

The PC revolution is spreading all over the world, and Unicode is poised to become the new standard character-encoding system that the world's languages require.

Morse code was not the first instance of written language being represented by something other than drawn or printed glyphs. Braille came earlier and was inspired by a system for coding secret military messages. And Morse code was not a binary system: The long and short pulses had to be separated by different delays between letters and words. Binary systems for representing written language (letters represented by a fixed-length series of 0s and 1s) came later.

One of the early binary systems used in telexes was called Baudot (named after a French engineer who died in 1903). Baudot was a 5-bit code. Normally, the use of 5 bits is limited to representing 32 characters, which is sufficient for the 26 characters of the alphabet (not differentiated by case) but not much else. However, one Baudot code represented a "shift" that made subsequent codes map to numbers and punctuation symbols. This feature extended Baudot to be nearly as extensive as a 6-bit code.

The American Standard Code for Information Interchange (ASCII) was crowned as a standard by the American National Standards Institute (ANSI) some 20 years ago. As defined by ANSI, ASCII is a 7-bit code, of which the first 32 codes and the last code are control characters (such as a carriage return, linefeed, and tab). That leaves room for 26 lowercase letters, 26 uppercase letters, 10 numbers, and 33 symbols and punctuation marks.

ASCII has become the dominant standard for all computers, except for mainframes made by a not-insignificant company called IBM. The IBM heavy iron machines use an 8-bit system called the Extended Binary Coded Decimal Interchange Code (EBCDIC). Using 8 bits should allow for twice as many codes as ASCII, but much of the EBCDIC code space is not assigned. One peculiarity is that EBCDIC doesn't represent the alphabet with consecutive codes—the capital letters A through I are hexadecimal codes 0xC1 through 0xC9; J through R are 0xD1 through 0xD9; and S through Z are 0xE2 through 0xE9. This only makes sense when you see the patterns on punch cards!

THE WORLD BEYOND OUR BORDERS With the exception of IBM mainframes, ASCII is just about the only standard common among computers. No other

standard is as prevalent or as ingrained in our keyboards, video displays, system hardware, printers, font files, operating systems, electronic mail, and information services.

But there's a big problem with ASCII, and that problem is indicated by the first word of the acronym. ASCII is truly an *American* standard, but there's a whole wide world outside our borders where ASCII is simply inadequate. It isn't even good enough for countries that share our language, for where is the British pound sign in ASCII?

Among written languages that use the Latin (or Roman) alphabet, English is unusual in that almost all of our words use the bare letters without accent marks. Go across the Atlantic and take a look at the French, German, or Swedish languages in print to see a variety of diacritics that originally aided in adopting the Latin alphabet to the differences in spoken sounds among these languages.

Journey farther east or south, and you'll encounter written languages that don't use the Latin alphabet at all, such as Greek, Hebrew, Arabic, and Russian (which uses Cyrillic). And if you travel even farther east, you'll discover the logographic Han characters of Chinese, which were also adopted in Japan and Korea. (Interestingly enough, in Vietnam you'll come across the Latin alphabet again, a triumph of sorts for early missionaries!)

I live in one of the most ethnically diverse cities of the world—New York. Every day I witness this diversity in a potpourri of languages heard and seen on the streets. There are Ukrainian churches, Korean delicatessens, Chinese restaurants, Pakistani newsstands, and subway advertisements in languages I don't even recognize.

And then I come home and use ASCII, a character-encoding system that is not only inadequate for the written languages of much of the world, but also for many people who live right in my own neighborhood.

We simply can't be so parochial as to foster a system as exclusive and limiting as ASCII. The personal computing revolution is quickly encompassing much of the world, and it's totally absurd that the dominant standard is based solely on English as spoken in the U.S.

I can't pretend to be dispassionate on this subject. The character encoding used in our computers must truly reflect the diversity of the world's people and languages.

ONGOING ATTEMPTS Of course, there have been some partial solutions to this problem. Because ASCII is a 7-bit code, and 8-bit bytes have become common in many systems, it is possible to extend ASCII with another 128 characters. The original IBM extended character set included some accented characters and a lowercase Greek alphabet (useful for mathematics notation), as well as some block- and line-drawing characters.

Unfortunately, this extended character set did not include enough accented letters for all European languages that used the Latin alphabet, so alternative extended character sets were devised. These are called *code pages,* and they still exist in DOS and (in great profusion) in OS/2. OS/2 users and programs can switch among code pages and get a different mapping of 8-bit codes to characters. An OS/2 program can even select extended EBCDIC code pages for over ten different languages!

Microsoft didn't entirely abandon the IBM extended character set in the first and subsequent versions of Windows, but most Windows fonts were built around an alternative extended character set. Microsoft called this the "ANSI character set," but it was actually based on an ISO (International Standards Organization) standard. The ANSI character set abandons the block- and line-drawing characters to include more accented characters that are useful for European languages employing the Latin alphabet.

But what about non-Latin alphabets? Some font vendors devised solutions to rendering other alphabets (such as Hebrew) with fonts designed specifically for that purpose. With such fonts, ASCII codes normally corresponding to the Latin alphabet are mapped to characters in other alphabets.

With either code pages or alternative fonts, the interpretation of 8-bit character codes is ambiguous because it depends upon the selected code page or font. And then there's the problem of communicating with the Macintosh, which uses a different extended character set than either the original IBM PC or Windows uses. Even when communicating over electronic mail in American English, I sometimes see odd characters in letters from my Mac-user friends.

Another response to the limitations of ASCII is the double-byte character set (DBCS). With DBCS, some characters require 1 byte and some require 2 bytes (indicated by an initial byte greater than hexadecimal 0x80). This system allows representing both the ASCII character set and a non-Latin alphabet. DBCS has problems of its own, though, such as multiple standards. Also, because DBCS characters are not of uniform length, programmed parsing becomes difficult. For example, you can't simply skip ahead 6 characters by skipping ahead 6 bytes. You have to look at each and every character to see if it's represented by 1 or 2 bytes.

UNICODE TO THE RESCUE The basic problem is that the world's written languages simply cannot be represented by only 256 8-bit codes. The previous solutions have proven insufficient and awkward. What's the *real* solution?

It doesn't take a genius to figure out that if 8 bits are inadequate, then 16 bits might be just fine. Congratulations! You've just invented Unicode!

Unicode is truly as simple as that: Rather than the confusion of multiple 256-character code mappings or double-byte character sets that have some 1-byte codes and some 2-byte codes, Unicode is a uniform 16-bit system, thus allowing the representation of 65,536 characters. This is sufficient for all the most common characters and logographs in all the written languages of the world (including some math and symbol collections), with about half the code space left free.

Sixteen-bit characters are often called *wide* characters. Wide characters do not necessarily have to be Unicode characters, although for our purposes I'll tend to use the terms *Unicode* and *wide characters* synonymously.

THE WINDOWS NT SUPPORT Of course, dealing with character codes that are 16 bits in length rather than 8 is quite a foreign concept to many of us. We are so accustomed to identifying a character with 8 bits that it seems unnatural and

impossible. What about our operating systems? What about our programming languages? What about our hardware and printers?

It's really not as bad as it sounds, although obviously quite a few years will pass before Unicode replaces ASCII as the universal system of character coding. Still, some essential support is already falling into place.

You can write programs for Windows NT that continue to use the ASCII character set, or you can write programs that use Unicode. You can even mix the use of ASCII and wide characters in the same program. How does this work? Well, every function call in Windows NT that requires a character string as a parameter (and there are quite a few of them) has two different entry points in the operating system. For example, there is a TextOutA function (the ASCII version) and a TextOutW function (the wide-character version); depending on the definition of an identifier, the name TextOut is defined as one or the other of them. We'll see how this works in more detail in a future column.

The ANSI standard for C also has support for wide characters, and this support is included in Microsoft's C compiler for Windows NT. Rather than using the strlen() function to find the length of a string, for example, you can use wcslen() (which translates to "wide character string length"). Instead of using sprintf() to format a string for display, you can use swprintf().

What about displaying non-Latin characters on our video displays and printers? Well, TrueType also supports wide character sets, and while a TrueType font file containing all the Unicode characters might be somewhere in the region of 5 to 10 megabytes, that's not an inordinate size for representing characters of all the world's written languages.

THE REFERENCE BOOKS Unicode is documented in two volumes compiled by The Unicode Consortium and published by Addison Wesley in 1991 called *The Unicode Standard: Worldwide Character Encoding, Version 1.0.*

Because the books contain charts showing all the characters of Unicode, they are marvelous to explore, and I highly recommend them. These books reveal the richness and diversity of the world's written languages in a way that few other documents have. In addition, the books provide the rationale and details behind the development of Unicode.

You'll probably be pleased to know that the first 128 codes of Unicode are identical to ASCII, thus facilitating a conversion from ASCII to Unicode. (Just add another zero byte to each ASCII character.) The second 128 characters are called the Latin 1 character set, which is the same as the Windows character set except that hexadecimal codes 0x0080 through 0x009F are defined as control characters in Latin 1. Many blocks of non-Latin characters are also based on existing standards, also easing conversions.

The question of whether Unicode can really replace ASCII as the standard for worldwide character coding is almost irrelevant. It simply must.

Codes 0x0100 through 0x01FF provide additional variations of the Latin character set. The codes 0x0400 through 0x04FF are for Cyrillic. Armenian, Hebrew, and Arabic come next, and soon you'll encounter more esoteric languages such as Devanagari (used in classical Sanskrit and modern Hindi), Bengali, Gurmukhi, and Gujarati (all North Indian scripts). And on and on and on.

The famous Zapf Dingbats character set uses codes 0x2700 through 0x27BF, and the Han ideographs begin at 0x4E00. These Han characters are used to represent whole words or concepts in Chinese, and they are also used in Japanese and Korean. Unicode contains over 20,000 Han characters, about a third of the entire code space.

WHAT UNICODE DOESN'T ADDRESS Sorting words in English is made easier by the consecutive coding of letters in the ASCII character set. The coding of characters in Unicode does not imply any collation sequence, and if you think about it, it doesn't make much sense to pretend that we know how to alphabetize a collection of words using different alphabets such as Latin, Hebrew, and Bengali.

Even sorting English words is not as straightforward as ASCII would imply, because alphabetizing words is usually case-insensitive. Thus, sorting always requires special consideration beyond the simple numeric sequence of character codes. And even with extended ASCII character sets, sorting gets more complex with the accented Latin letters of many European languages. But at least with Unicode we have a consistent encoding of accented letters, so a table could be created that allows reasonable sorting.

Another issue Unicode doesn't address is the use of similar alphabets and logographs in different countries. For example, there are no separate French, German, or Finnish character sets within Unicode. The written languages of these countries share many unaccented and accented Latin characters.

The situation is similar for the Han logographs. Quite often, the same Han character represents something different depending on whether it's used in Chinese, Japanese, or Korean. Unicode makes no attempt to reflect these differences. If the character is in Unicode, then it can be used in any of those three languages, regardless of its meaning.

Another problem with international programming is that some written languages do not run from left to right on the printed page. Unicode specifies that character strings be stored in logical order, which is the order that someone would type the characters from a keyboard. Properly displaying such text is left up to an application, but the Unicode reference books contain some information on this issue.

CAN IT BE DONE? Unicode is certainly an important step in the move towards truly international programming. The question of whether it can really replace ASCII as the standard for worldwide character coding is almost irrelevant. It simply must.

In my next columns on this subject, I'll refrain from further proselytizing and will focus on the programming mechanics involved in using Unicode. □

Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

PCs

RUNNING WINDOWS ON LAPTOPS

❓ I have a Compaq LTE 286 portable with a 20MB hard disk, 2.7MB of RAM, and a math coprocessor. What do I have to do to upgrade this system so it will run Microsoft Windows 3.1, Word for Windows, and Excel?

Fridrik Bjarnason
Reykjavik, Iceland

▶**PC MAGAZINE:** While it's possible to install and run Windows 3.1 on this system, you probably don't want to. Your money would be better spent on one of the new-generation laptops designed to run Windows.

Windows 3.1 can run on a 286, but you don't get the benefits of virtual memory and other performance features that you get in 386 Enhanced mode. The Windows specification also recommends at least 1.6MB of memory, while Word for Windows and Excel each require at least 2MB. Even though you have this much memory, performance would be improved by adding more. Unfortunately, you can't add any more memory to your laptop.

The 20MB hard disk also poses a problem. Windows requires 6MB (although 10MB is recommended), Word for Windows needs 5MB for a minimum installation (15MB is needed for the complete program), and Excel requires another 5MB. You'd need to switch to at least a 40MB drive, and an 80MB model would be even better.

Your double-scan CGA display may also be inadequate. Many users find it too coarse to use for a graphical interface such as Windows.

Finally, the LTE 286 processor runs at only 12 MHz, and even if you could resolve the memory, storage, and display limitations, there's no way around the CPU bottleneck. You can buy a 386SX portable that runs nearly twice as fast, with an 80MB hard disk, plenty of memory, and a VGA LCD panel, plus DOS and Windows already installed, for about $1,000. Trying to run Windows 3.1 applications on anything much less than this is likely to be a source of frustration and disappointment.—*Alfred Poor*

Peripherals

MAXIMIZING YOUR IMAGES

❓ I'm having a problem with the display on my new computer. When I run Windows, I adjust the image so it fills most of the screen. When I switch back to DOS, however, the image is off the top, right-hand side, and I have to readjust the picture. The company's technical support department told me this was normal and instructed me to set the image to a smaller size so it still fits on the screen when I switch back to DOS. This solution will certainly solve the problem, but it seems like a waste of screen space. Do you think there is something wrong with the system?

David Mahaffy
Sioux Center, Iowa

▶**PC MAGAZINE:** It's possible that this is normal for your monitor and display card combination, but there are some other things you can try before giving up on the display real estate.

The problem stems from the fact that the monitor is trying to synchronize the different signals being produced by the video adapter card. Despite what you might expect, there are wide variations in timing among the signals produced by various cards. There are also wide variations among the kinds of signals that dif-

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See index, page 477.

ferent monitors are set up to receive.

With more expensive monitors (especially those that have digital controls), there are ways to configure the monitor so it stores the image size and position settings for various signals. Based on what you describe, however, it sounds as if the monitor has analog controls, and consequently there is no way for you to store the picture settings. Instead the picture settings are set at the factory in anticipation of receiving signals with particular timings.

If this is the case, you may be able to solve the image-size problems by using a different Windows video driver. Try to configure the video adapter for other resolutions, color depths, and refresh rates. Some video cards also have separate utilities that configure the board's signals for various monitor models; try different monitor settings to see if one works better than the others.

If neither of these suggestions solves the problem, you are left with two choices: You can either live with the smaller image on-screen or replace your video card or monitor with one that's a better match for the remaining component.—*Alfred Poor*

Our Advisors

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Ethan Winer is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities.*

FASTER DISPLAYS IMPROVE YOUR FLIGHT

❓ Flight simulators and air combat games can be a lot of fun, but the jerkiness of the screen image causes problems. In some cases, the frame rate is so slow that the game is unplayable. What can I do to speed up the image?

Ryan Hoffman
St. Louis, Missouri

▶**PC MAGAZINE:** The flight simulation enthusiast's eternal quest is for a faster frame rate. Unfortunately, this is matched by a desire for detailed scenery and more realistic three-dimensional objects, which tend to slow down displays considerably. But there are some things you can do to shift the scales in favor of faster displays.

First and foremost, many programs have configuration options that you can set to decrease the level of complexity in the displayed image. Turn off ground texture and shading as much as possible. Eliminate any extraneous objects (like other planes) if they are not critical to the game experience.

Check the availability of special drivers for your video card, or think about purchasing a card that has drivers included. For example, there are special drivers under development for some of the ATI cards that can be used with Microsoft Flight Simulator. (You can download beta versions of the drivers from CompuServe's Flight Simulator forum (GO FSFORUM).)

If you're buying a new system, consider purchasing one with a local-bus video feature. Many users are reporting that they achieve significantly faster frame rates for their flight simulators when running a VL-Bus motherboard and video adapter.

Surprisingly, a math coprocessor rarely has an impact on display speed. Many programs rely on integer math for their calculations, and support for a floating-point coprocessor wouldn't have a major impact on performance. However, there are a few programs that can take advantage of a coprocessor, so it pays to check your program requirements.
—*Alfred Poor*

HOW TO CONTACT US

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Operating Environments

CAN OVERWRITTEN FILES BE RECOVERED?

❓ Sometimes I unintentionally replace one file with another. In WordPerfect, for example, I might retrieve an existing file named LETTER1 and make extensive changes, perhaps deleting large portions of it. I *intend* to save the file as LETTER2 but mistakenly save it as LETTER1. And when WordPerfect asks "Replace LETTER1?" I unintentionally answer Yes, and the new LETTER1 replaces the old LETTER1. Is the original file lost forever?

I reviewed the Norton Utilities documentation and learned they can recover a file that has been *deleted.* But can I use The Norton Utilities to recover a file that has been *replaced* under the same name?

Robert D. Hoagland
Charlotte, North Carolina

▶**PC MAGAZINE:** Unfortunately, overwriting a file is a much more permanent action than just deleting it! To delete a file, DOS changes the first character in the file's directory entry to mark it as deleted, and it marks the disk space occupied by the file as available for reuse. The file's data is completely untouched by the deletion process, at least until the data space gets recycled. That's what makes unerase utilities possible—the only information lost when you delete a file is the first letter of the filename.

When a program *overwrites* a file, either the new data will directly replace the old on-disk, or the program will wipe out the old file and create a new file with the same name. In the first case, the data is totally lost. In the second case, there's a chance that the file's data still exists on-disk. However, there's no deleted directory entry to give an unerase program a toehold. You might be able to locate and gather chunks of the file's data with The Norton Utilities, but it would be a tedious process with no guarantee of success.

DOS 6.0 adds a new Delete Sentry feature to the UNDELETE utility, and when it's active you can recover some overwritten files. To protect drive C: with Delete Sentry, add a line like

```
UNDELETE /SC
```

to your AUTOEXEC.BAT file. Now when files on drive C: are deleted, DOS will move them to the hidden directory C:\SENTRY. If the sentry files take more than a specified percentage of disk space, DOS deletes the oldest. Delete Sentry protection costs you disk space, and UNDELETE remains resident in RAM, so this partial protection from overwriting files comes at a price.

In the example you describe, you could configure WordPerfect to make backups of the original file before overwriting it. Press Shift-F1 to enter Setup, E for Environment, and B for Backup options, and set the "Original Document Backup" option to Yes. Now when you overwrite a file in WordPerfect, the original will be saved, with its extension changed to BK!—*Neil J. Rubenking*

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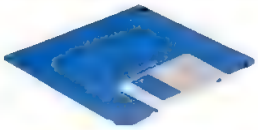

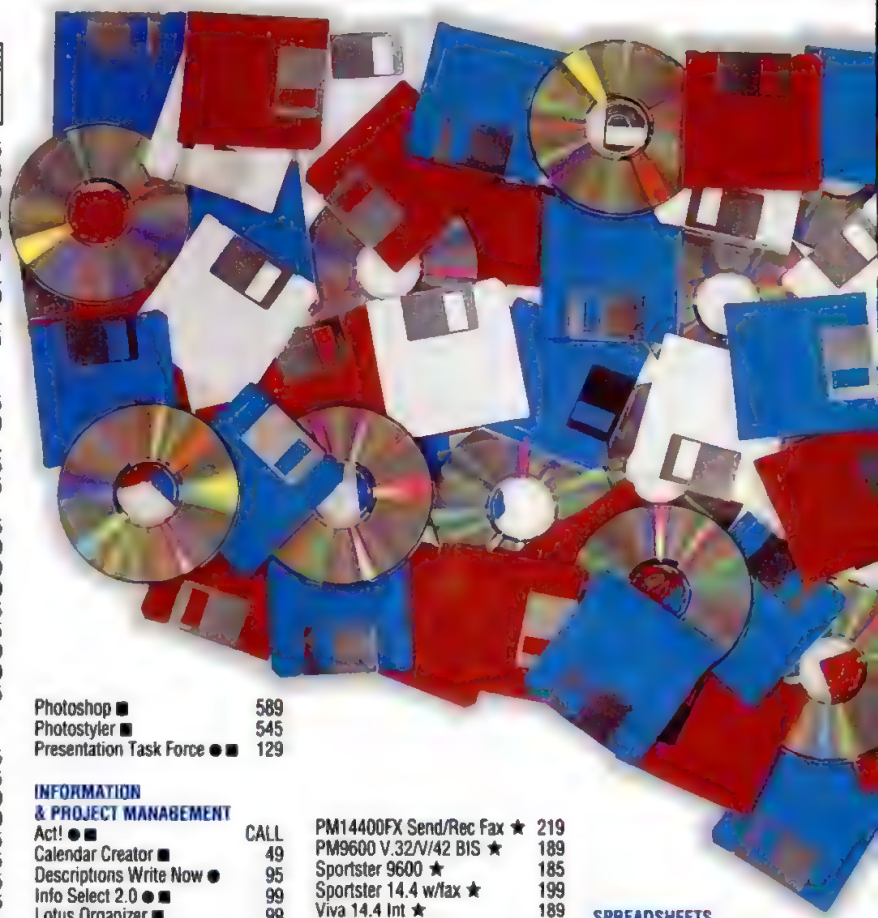

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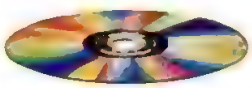

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SHRINKING YOUR PATH

TIP As I added more and more software to my hard disk, my PATH grew out of control. Since I almost always start programs from within Windows, I simply set the correct location of each program with the Command Line item in the Program Item Properties dialog box. If I do want to start a program from the DOS prompt, it's no great hardship to change to the appropriate directory. Now my PATH is just C:\DOS;C:\WINDOWS!

Mark D. Mylin
Willow Street, Pennsylvania

▶PC MAGAZINE: These days it seems like every program—whether it is based in DOS or in Windows—wants its directory on your PATH. There's a practical limit of 122 characters: the 127-character limit of the DOS command line minus the 5 characters, PATH=. And the longer the PATH, the longer it takes DOS (or Windows) to determine that a given program is *not* on the PATH. Windows has the built-in ability to associate a full pathname with each Program Manager icon. It takes only a few minutes to add this information for all your programs, and then your PATH can shrink to almost nothing.

There *is* one more step you need to take before you can shrink your PATH. Open the WIN.INI file and find the [extensions] section. Entries in this section define associations between particular file extensions and the programs that act on those files. Fill in the pathname for any program that doesn't reside in the DOS or Windows directory. That's all!
—*Neil J. Rubenking*

Word Processing

PRINTING CHECK BOXES IN WORDPERFECT

TIP If you're preparing a list or form in WordPerfect and you need check boxes, you can use the box that you get with the compose character 4,38 (entered with Ctrl-V, 4, 38, Enter). However, the character is somewhat small for a check box, and it hangs above the line. Getting the check box properly sized and lined up with the rest of the text can be a challenge.

You can meet the challenge with this simple macro—assuming only that your printer can vary type size:

```
{DISPLAY OFF}{Format}oad.025{Enter}00
{Font}sv{^V}4,38{Enter}{Right}
{Format}oau.025{Enter}00
```

The first line uses the Advance Down command to move the printing position down by 0.025 inches. The second line sets the font size to Very Large, enters the box character, and moves the cursor one character to the right, so it's beyond the code that turns Very Large size off. The third line uses the Advance Up command to return the printing position to the proper place for the line. You can enter this entire macro by recording it. Use Shift-F8 to enter the {Format} command, Ctrl-F8 for the {Font} command, the Enter key for {Enter}, and the Right Arrow key for {Right}.

Larry Christenson
Northome, Minnesota

▶PC MAGAZINE: Some might argue that the compose box character 4,38 is just fine for a check box as is. However, it's a little small to be useful at point sizes of 12 and below, serving better as a fancy bullet than a check box. The above macro provides a simple way to make the box large enough to be useful with smaller text, without making it unreasonably large with larger text.

There are one or two variations you might want to try on the macro as shown. If you use this macro to create a check box with text in various fonts and point sizes, you'll find that the relative size and position of the box in relation to the text varies with font and point size. It will also vary somewhat depending on your printer.

With my Canon LBP-8III, for example, using 12-point (10-cpi) Courier, the box is noticeably taller than it is wide, and noticeably taller than the text. Using 12-point Dutch (the equivalent of Times Roman), however, the box is square and only a little taller than the text. With compose character 5,24 rather than 4,38, the resulting box is closer to square in all cases.

You may also want to experiment with positioning. Based on tests with several fonts in sizes from 12 to 20 points, the 0.025-inch shift up and down is a good compromise with compose character 4,38 for all fonts, but the positioning clearly varies, so that in some cases the text is vertically centered on the box, while in others the bottom of the text is almost on a line with the bottom of the box. Much the same is true for compose character 5,24, except that 0.05 inches is a better overall compromise for my printer.

If you use check boxes extensively in your forms and you use widely varying fonts and sizes, you may even want to create slightly different macros with custom positioning for different fonts and sizes. And, finally, as a minor aesthetic consideration, you might want to change the 00 at the end of the first and third lines with {Exit}, entered by pressing F7.

Note that for the macro to work—in any variation—WordPerfect not only has to vary text size, but it has to support one of these compose characters on your printer in the first place. This should almost always be true for 5.1, since WordPerfect will create the character as a graphic if necessary, but may not be true for 5.0, since 5.0 can only use characters that are already available—in the printer, as downloadable fonts, or elsewhere on your system.

Also, the printer has to be able to move print position both forward and back. Some older printers may not be able to follow the Advance Up command to move back to the starting position. If your printer can do subscripts and superscripts, however, it shouldn't have a problem.—*M. David Stone*

START WINWORD IN A DATA DIRECTORY

TIP By default, when you start up WinWord the program assumes you want to load files from and save them to the WinWord program directory. Since I often want to work on files in another directory, I've found a simple way to tell WinWord to use a different directory instead.

Windows 3.1 can associate particular

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file extensions with particular programs—as with the .DOC extension for WinWord. If you set up your screen so you can see both File Manager and Program Manager at the same time, you can drag a file icon from File Manager to a Program Manager group, and Windows will convert it to the associated program icon to create a new entry in Program Manager.

Use a .DOC file to create a new icon this way, then start WinWord from the new icon, and the program will start up with the file loaded that you dragged over to Program Manager. The default file directory will also become the directory you loaded the file from.

You can take advantage of this feature to tell WinWord to use your preferred data directory. Create a blank file and save it under some descriptive name, such as BLANK.DOC or DATADIR .DOC. Then drag the file's icon into Program Manager. At this point, Windows should show the item as a WinWord icon. With the icon selected, choose File | Properties, change the description to WinWord in the Description text box, and choose OK.

You should now be able to open WinWord by clicking on this new icon or selecting it and hitting enter. Test the icon to make sure it works, then delete the original Winword icon from Program Manager by highlighting it and choosing File | Delete or hitting the Del key.

From now on, you'll be able to start WinWord in the right directory with the new icon. WinWord will load the blank file, but you can simply close the file and then load any file you want, without having to first go through the cumbersome process of changing the directory through the File | Open dialog box.

Willard Kirste, Jr.
Downsville, Louisiana

▶PC MAGAZINE: This suggestion tackles one of Microsoft's most annoying habits: encouraging you to dump all your files into a single directory. There are several approaches to starting in separate data directories, but as with Mr. Kirste's solution, they're all somewhat hidden from view.

Creating an icon that will open a specific file is best reserved for those files that you actually want to open—as with a to-do list or calendar that you update regularly. Opening WinWord with a blank file loaded and then closing the file takes you to the right directory (with one exception we'll come to later), but having to close the file is unnecessary work.

A more direct way to start WinWord in the directory of your choice is to change WinWord's Working Directory. To do this, you highlight the WinWord icon in Program Manager and choose File | Properties. By default, the properties are set as WINWORD.EXE in the Command Line text box, and the WinWord program directory (typically C:\ WINWORD) in the Working Directory text box. In the File Properties dialog box, make sure WINWORD.EXE is preceded by its drive and full path in the Command Line entry, then change the Working Directory entry to the data directory of your choice. Now when you start the program from the icon, WinWord will wake up set to use your preferred data directory.

If you define the default data directory this way, you should be aware that the Working Directory entry will have no effect if you start WinWord another way—such as from the File Manager or by launching it from another program. This can be a plus if you use icons that start up with a particular file loaded, as described by Mr. Kirste, since they'll still work as intended.

There's another way to set WinWord's start-up directory, and it too overrides the Working Directory setting. One of the optional entries in the [Microsoft Word 2.0] section of the WIN.INI file is `DOC-Path=`, which you can use to define the default document directory. The entry takes the form

```
DOC-Path=D:\DATAPATH
```

where D:\DATAPATH is the drive and path for the data directory. You can add this line to your WIN.INI file directly with any text editor. Simply open WIN .INI, search for Microsoft Word 2.0 to find the WinWord section, and add the entry on its own line.

Alternatively, you can enter the line from within WinWord without opening WIN .INI. Choose Tools | Options, then choose WIN.INI in the Category list box. WinWord will show you the Microsoft Word 2.0 section of WIN.INI. You can then browse through the Startup Options list box to see if there is already a DOC-path in the file.

If there is a DOC-path, you can change the setting by highlighting the line in the Startup Options list box, making the change in the Setting text box, and then choosing set. If there isn't a DOC-path entry, you can create one by typing DOC-Path in the Option text box, typing the appropriate path in the Setting text box, and choosing set.

WinWord will use the DOC-Path entry as its default data directory no matter how you start the program—even if you start it from File Manager, or start it from Program Manager using an icon that loads a specific file. If you only have one data directory or you absolutely want WinWord to start in the same directory every time, this method is your ticket. However, unless you have very few data files, it makes more sense to divide your files into directories—by project, client, type of file, or any other way that makes sense for the way you work.

If you use the Working Directory entry to define the default data file, rather than the DOC-path entry, you can create more than one WinWord icon, then start WinWord with the appropriate icon for the data directory you want to use.

—M. David Stone

Spreadsheets

ADDING ALTERNATE ROWS

❓ I have been trying to write a small macro routine in Lotus 1-2-3, Release 2.01, that adds every other line in a range. For some reason I have been unable to get the following code to work:

```
{for A100,1,51,2,L5}
@sum(L5..L55)
```

The starting point of my range is L5, and the ending cell is L55; I want to add all the odd-numbered lines, including L55. I wonder if you can help me do this.

Jak Ninyo
New York, New York

ALTADD.WK1

Complete Listing

```
      A                                    B
104  \s     {windowsoff}{paneloff}
105         {let total,0}
106         {goto}startcell~
107  loop   {let total,total+@cellpointer("contents")}
108         {down 2}
109         {if @cellpointer("type")<>"v"}{goto}total~{left}{quit}
110         {branch loop}
111
112  total
```

Figure 1: **This 1-2-3 macro adds up every other number in a column.**

▶PC MAGAZINE: The {for} command takes five arguments—a *counter cell,* a *starting value,* an *ending value,* a *step value,* and a *cell reference.* The last argument should be a reference to an address containing some macro code. The command tells 1-2-3 to do the following:

1. Set *counter cell* to *starting value.*

2. Execute the code at *cell reference.*

3. Increment *counter cell* by *step value.*

4. If *counter cell* is now greater than *ending value,* stop. Otherwise loop back to step 2 and continue.

From your letter, it sounds as though cell L55—the cell reference argument in your {for} statement—does not contain macro code; it appears instead to contain one of the numbers that you want to add. But even if L55 contained the statement @SUM(L5..L55), your macro would merely execute that formula 25 times, yielding the same result on each execution. In other words, {for} is the wrong tool for this job!

The macro shown in Figure 1 should do the trick. The first line of this macro turns off screen and panel updates for the duration of the macro run. This is optional, but the macro will be hopping through the range that it's adding, so without {windowsoff} and {paneloff}, 1-2-3 will have a lot more work to do.

The second line initializes a cell named *total* to 0. This one is important; if you omit it, each run of the macro will add a new value to whatever was in total before.

Line three moves the cellpointer to the start of the range you want to add. I've given this cell the name *startcell* for the sake of generality. If you're always going to be adding the same range of numbers (L5..L55, for example), you could hard-code the starting address.

Line four, to which the name *loop* has been assigned, adds the value at startcell to the value of total. Line five moves the cellpointer down two rows. Line six checks to see if the current cell is blank—that is, to see if we've come to the end of the range. If the cell is blank, the macro has finished, so it does a {goto} to the total cell, then moves one cell to the left so you can see the word *total.* Then the macro stops.

If the current cell is not blank, the macro branches back to loop and the process is repeated.

For this to work, you must do the following:

1. Assign the names *\s, loop,* and *total* to the cells immediately right of those labels. In Figure 1, those cells are B104, B107, and B112, respectively. On your worksheet, however, they may be different.

2. Assign the name *startcell* to the first cell you want to add.

3. Leave two blank cells directly below the range you want to add.

Be aware that this macro doesn't produce a "dynamic" formula. If you change the values in the range you're adding, you'll need to rerun the macro.
—Craig Stinson

CLIPBOARD SHORTCUTS IN EXCEL DIALOGS

TIP I use Excel 4.0 for generating price quotations on computer equipment. I find the FormulaNote command very useful for adding text to explain the significance of new product technology. Unfortunately, while you're in the Note dialog box, the Edit menu is unavailable, so you can't choose the Paste command to copy text in from the Clipboard. Nor is there a button in this dialog box that would let you import a text file from disk. I searched through the manual and found no help. I even called Microsoft's technical support line and got no help. So I resigned myself to retyping information directly into the Note window.

Then quite accidentally, I happened to press Ctrl-V one day while creating a note, and voilà, I got a paste from the Clipboard. It turns out the keyboard shortcut works even though the Edit menu is not available. This discovery has proved to be a major time-saver for me.

Bob Chambers
Unionville, Ontario

▶PC MAGAZINE: A handy discovery, indeed. The other Clipboard shortcuts—Ctrl-X to cut and Ctrl-C to copy—also work in the Note window. And all three shortcuts also work in some other contexts where the Edit menu should be, but is not, available. For example, you can use these shortcuts in the Data | Form window or in a custom dialog box created via macro.

One thing you cannot do, however, is select a worksheet cell, copy it to the Clipboard, then choose the Note command and paste the cell with Ctrl-V. You must fill the Clipboard from an application other than Excel. When you copy from Excel to the Clipboard, Excel expects your next step to be a paste. If you do anything else before pasting—such as pulling down the Formula menu and choosing Note—Excel empties the Clipboard.*—Craig Stinson*

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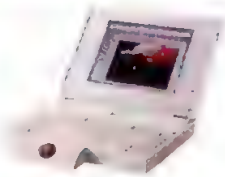

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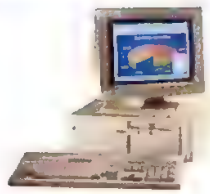

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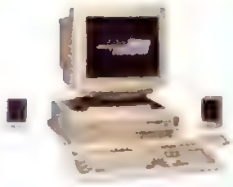

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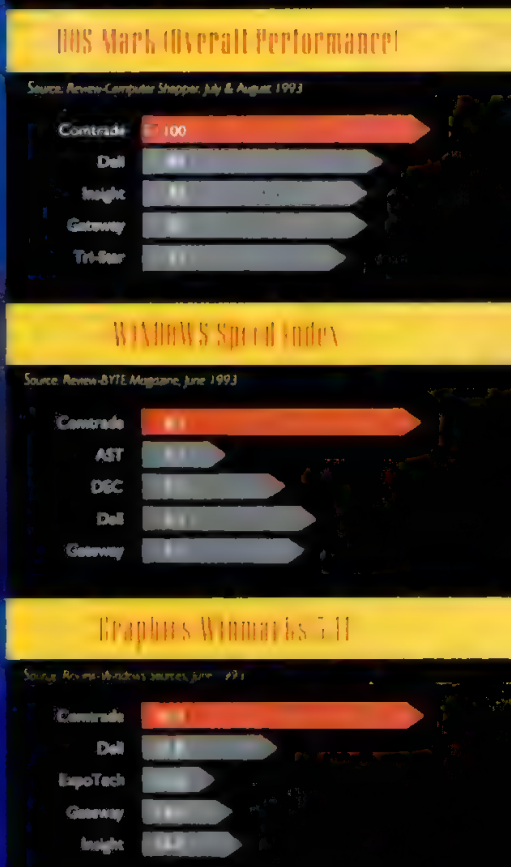

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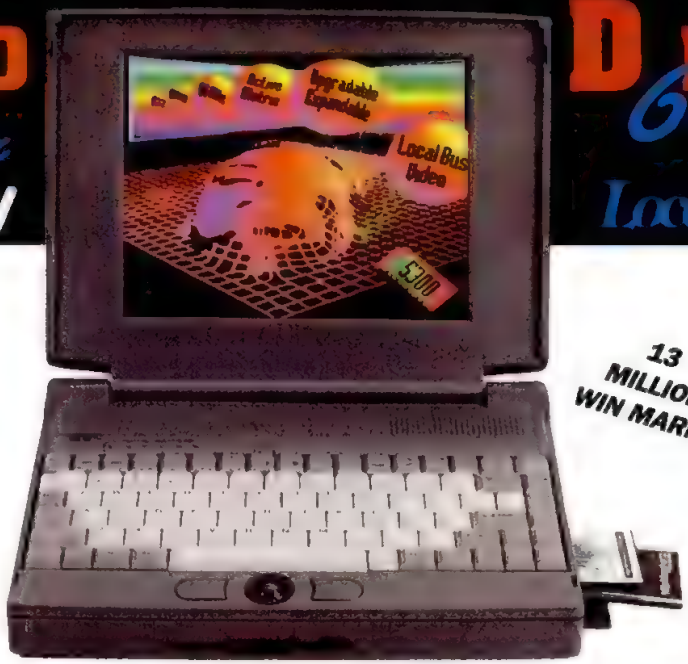

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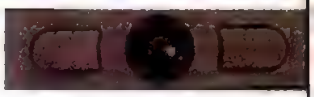

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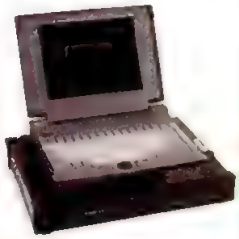

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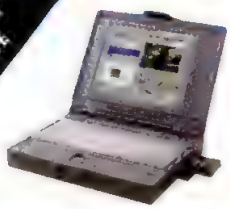

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4533 STN Passive Color	$2295
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Tonga tribe, or only information containing both the words *Tonga* and *Zambia*. I would conceive of the information's being recorded as we would have done it in the old days—on a 3- by 5-inch index card that would have a heading followed by several paragraphs of information. Do you know of any program that would make this sort of recording/searching/sorting possible?

Allen Avery
Martinsville, Indiana

▶PC MAGAZINE: You need a package that specializes in free-form information management. Many traditional PC database management systems require that you structure your information into fixed-length fields or variable-length "memo" fields. And unfortunately, the FoxPros and Paradoxes of the world don't have a lot of features that facilitate free-form text storage and retrieval. However, two packages that do specialize in working with free-form text flexibly are askSam (askSam Systems, P.O. Box 1428, Perry, FL 32347; 800-800-1997, 904-584-6590; $395) and ZyINDEX (ZyLAB, 100 Lexington Dr., Buffalo Grove, IL 60089; 708-459-8000; $395).

askSam is an information manager that lets you mix and match both structured and unstructured data. You can create records that include delimited fields as well as free-form text, or you can choose to go the completely unstructured route. You can query and search for information in a variety of ways, and combine search expressions using Boolean operators such as AND and OR. askSam stores information in a proprietary format and includes a data entry facility.

ZyINDEX is a file indexer used for text indexing and retrieval. While askSam includes a text editing facility, ZyINDEX acts more as an accessory to your own text editing tools. To use ZyINDEX you first create your documents (or records) independently using your own favorite tool, and then use ZyINDEX to generate indexes and search your documents. You'll find ZyINDEX's search facilities to be quite flexible. Since ZyINDEX is only an index and retrieval tool, you cannot edit records from within ZyINDEX—you must use your own tools. And you must ask ZyINDEX to update its indexes whenever you make changes to your documents. Fortunately, ZyINDEX supports a wide variety of popular file formats, including Microsoft Word for Windows, WordPerfect for DOS and Windows, XyWrite, and ASCII, to name a few.

Which should you choose? askSam seems better suited to your request, since it's a single-product solution that lets you flexibly record and search/sort your information. Note that the documentation is somewhat weak, and the product itself is a little difficult to learn. It'll require some experimentation. ZyINDEX is a better choice if you would like to do all your editing using your own word processor. ZyINDEX may perform some queries faster than askSam, since askSam does not build indexes. The trade-off, of course, is that with ZyINDEX you must keep your indexes current.
—*Sal Ricciardi*

A VARREAD() CAUTION

▶PC MAGAZINE: The VARREAD() function in FoxPro is designed to return the name of the memory variable, array element, or field used in the currently active GET. You'll recall that the GET statement is used to edit a value on the display.

The VARREAD() function is useful, for example, in a function called by the WHEN or VALID clause on your GET statement. The WHEN function is called before the user enters the edit field, and the VALID clause is called when the user leaves the field. With VARREAD(), you can write a function that determines for itself which GET is currently active.

For example, if the active GET is editing a memory variable named Last, the VARREAD() function would return LAST. Note that if the GET is editing a field named Last, as opposed to a memory variable, the VARREAD() function *still* returns just LAST. Unfortunately, the VARREAD() function does not prefix memory variable names with M. or field names with the table alias and a dot. This can cause problems if you're not careful.

For example, consider the following, where the Cust table has a field named Last:

```
USE Cust
m.Last = "Ralph"
@ 10,10 GET m.Last ;
  WHEN foo() VALID foo()
READ
RETURN

FUNCTION foo
PRIVATE mv
mv = VARREAD()
mval = &mv
@ 20,10 SAY mval
RETURN
```

In the foo function, the mv memory variable is set to LAST by the VARREAD() function because the active GET is a memory variable named Last.

The next statement stores the value of LAST to the mval memory variable. Unfortunately, because the Cust table is open and has a field named Last, the field's value is returned—not the memory variable's value.

Hence, when you use VARREAD() you must remember that it does not distinguish between memory variable names and field names (a flaw, in my opinion). If you know that you want the memory variable and not the field, you can work around this by using "M." +VARREAD() instead. —*Sal Ricciardi*

Graphics

KEYBOARD SHORTCUTS IN PAGEMAKER

TIP I enjoyed your tip on creating hanging quotes in PageMaker 4.0 by placing quotation marks on every line and making the unnecessary ones invisible ("Dangling Display Type," February 9, 1993). But when it comes to using special characters such as typographical quotes, em dashes, or en spaces, PageMaker provides a better and faster way than the Windows Character Map—the keyboard.

Here's a list of the most common special typographical characters, together with the key combinations you need to access them in PageMaker.

- Double Open Quote: Ctrl-Shift-[
- Double Close Quote: Ctrl-Shift-]

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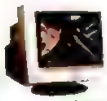

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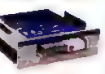

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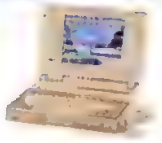

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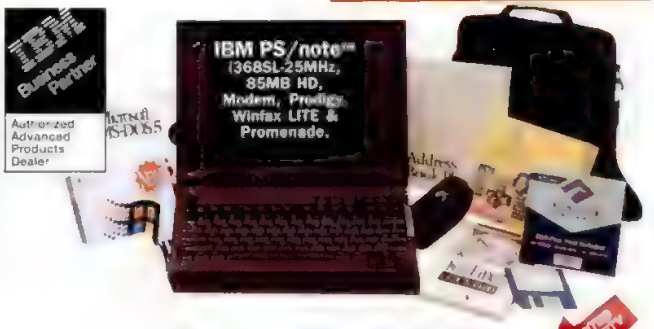

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- Em Dash: Ctrl-Shift-=
- Em Space: Ctrl-Shift-M
- En Dash: Crtl-=
- En Space: Crtl-Shift-N
- Bullet: Ctrl-Shift-8

Denton Taylor
Brooklyn, New York

▶PC MAGAZINE: Oops! Sometimes in my enthusiasm for new graphical ways to accomplish tasks, I forget to mention good old-fashioned keyboard shortcuts. Thanks for the reminder!—*Luisa Simone*

BECOMING MAC-COMPATIBLE

❓ I'm a fan of the DataViz product Mac Link Plus which makes file transfer between Mac and PC application programs transparent by allowing me to read DOS disks on my Macintosh. Are there any programs for Windows that do file transfers in the same way—without any special cables or hardware?

Robert Leong
Darussalam, Brunei

❓ I've recently purchased a new IBM-compatible computer after having relied on an original 128K Macintosh for the past nine years. I'm very happy with my system, and the transition to Windows hasn't been as painful as I expected.

My problem is that I've accumulated a multitude of Mac files that are stored on 3.5-inch, 400K single-sided Mac floppy disks. Many of the files are text files created in various versions of MacWrite that I'd like to convert for use on my new system. Several local vendors say they can convert the files, but since they charge by the file, the cost would be more than I paid for my computer!

Do you know of any software I can use to convert the files?

James M. Gambill
Sumter, South Carolina

▶PC MAGAZINE: There are software-only solutions that will allow a PC to read a Macintosh disk—as long as both your Mac and your PC include 3.5-inch, 1.44MB high-density floppy disk drives.

But—there is a big difference between transferring a file from one platform to another and converting a file to make it usable on a different platform. Typically, programs that offer transfer functions do not include conversion utilities. And with few exceptions, programs that specialize in conversion utilities do not address the issues of file transfer.

If you only need transfer functions, there are several programs on the market that should be able to meet your needs. Mac-to-DOS Transfer ($179, PLI, 800-288-8754) and Mac-In-DOS ($199, Pacific Micro, 415-948-6200) are both DOS-based programs that allow your PC to read and write Mac floppy disks and also let you format Mac disks on the PC. If cost is an issue, you might try using a shareware program called Mac-ette, from Acute Systems, that can read and write (but not format) Mac floppy disks. Mac-ette has a modest licensing fee of only $20.

If you want a Windows-based Mac-to-PC transfer program, you have two options: you can either purchase the Windows version of Mac-In-DOS for $249, or you can wait. PLI has announced Mac-to-DOS for Windows, which will cost $189 and ship in the third quarter of 1993. In addition, DataViz, the company that makes MacLink Plus for the Macintosh, has announced a PC product called Conversion Plus for Windows ($149, DataViz, 203-268-0030). Conversion Plus—which should be shipping by the time you read this—allows you to both transfer *and* convert files between PC and Mac programs. Like its Mac sibling, Conversion Plus for Windows offers a library of translation routines for such popular word processing programs as MacWrite, Ami Pro, Microsoft Word, Word for Windows, and WordPerfect. Conversion Plus can also translate between the Windows metafiles and PICT picture formats (even if the pictures are embedded in a word processing file).

The issue of conversion is a sticky one. You may find that programs like Word for Word/Professional ($149, The Software ToolWorks 415-883-3000) or Software Bridge ($99, Systems Compatibility Corp., 312-329-0700) provide the perfect conversion utility for your mix of word processing programs. Neither of these programs, however, will let you read a Mac disk from your PC floppy disk drive.

If you are working with the most current graphics programs, you may have little or no need of conversion utilities because many of today's desktop publishing, drawing, and image-editing programs produce files that are binary-compatible across platforms. For example, QuarkXpress for Windows can read Mac QuarkXpress files directly, and the Adobe PhotoShop format is identical on both platforms. The same is true of graphical business applications. Excel files, for instance, can be opened on the Mac or under Windows. If you plan to regularly transfer files between a Mac and a PC, plan ahead and use application programs and file formats that are cross-platform compatible. For example, instead of generating .BMP files (a Windows-specific format) with your scanning software, create TIFF or EPS files because both Macs and PCs can read them. One caveat: Even if your application boasts cross-platform compatibility, you'll still need to massage the filename in order to deal with the incompatible filenaming conventions of the Mac and PC operating systems. Mac files can contain 32 characters as opposed to the DOS filename limit of 8. Mac filenames can also contain characters that are illegal in DOS, such as the question mark, backslash, and asterisk. Finally, Mac filenames don't need an extension, but many DOS and Windows applications require them. All the transfer utilities mentioned above let you rename files as part of the move from one platform to another.

As a last resort, you can export all of your Mac application files to ASCII and then transfer the ASCII files to the PC. Although vanilla ASCII is identical on the Macintosh and under DOS, the two platforms use different characters to define line endings. The good news is that all of the programs listed here—even the file transfer programs like Mac-In-DOS and Mac-to-DOS Transfer—can replace the line ending character that is used on the Mac (a carriage return—13) with the line ending characters required by the PC (two carriage returns followed by a line feed—10).

If you're working with any other Mac format—that is, either a 400K or 800K disk—you'll have to use a combination of hardware and software to transfer files

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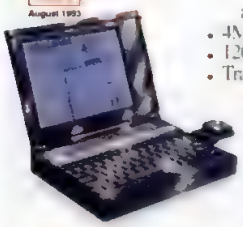

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250MB	12ms	3.5" 1"H	Conner	IDE	CP3Ø254	349	369
340MB	12ms	3.5" 1"H	Western Digital	IDE	WD234ØA	329	349
452MB	12ms	3.5" 1"H	Seagate	IDE/SCSI	ST355ØA/N	529/609	549/759
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*Some configurations do not ship with Windows.

VESA Value Systems

486DX-33 $1529
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Elements

- VESA Local Bus Motherboard
- Intel 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 32-Bit VESA Local Bus IDE Card
- 245 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 1.2 Mb 5.25" Floppy Drive
- 14" SVGA .28 Non-Interlaced Color Monitor
- 32-Bit VESA Local Bus SVGA Video Card
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- 5-Bay Mini-Tower Case
- FREE Microsoft DOS 6.0 Installed
- FREE Microsoft Windows Installed

486DX2 -50 $1599
#006330

486DX2 -66 $1749
#006331

VESA Windows Systems

486DX-33 $1699
#006332

Elements:

- VESA Local Bus Motherboard
- Intel 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 32-Bit VESA Local Bus IDE Card
- 245 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 1.2 Mb 5.25" Floppy Drive
- √ 15" SVGA .28 Non-Interlaced Multi-Scan Color Monitor
- √ Diamond Stealth 24 VESA Local Bus SVGA Video Card
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- √ 7-Bay Full-Tower Case
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- FREE Microsoft Windows Installed

486DX2-50 $1749
#006333

486DX2-66 $1899
#006334

VESA Multimedia Systems

486DX-33 $1929
#006335

Elements:

- VESA Local Bus Motherboard
- Intel 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 245 Mb IDE Hard Drive
- 32-Bit VESA Local Bus IDE Card
- 1.44 Mb 3.5" Floppy Drive
- √ Dual Speed Multi-Session Multimedia CD-ROM Drive
- √ 3 Disk CD-ROM Software Library
- √ 16-Bit High-Performance Sound Card
- √ Digital-Quality, Compact Speakers!
- √ 15" SVGA .28 Non-Interlaced Multi-Scan Color Monitor
- 32-Bit VESA Local Bus SVGA Video Card
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- 5-Bay Mini-Tower Case
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- FREE Microsoft Windows Installed

486DX2-50 $1999
#006336

486DX2-66 $2149
#006337

VESA CAD Systems

486DX-33 $2329
#006338

Elements:

- VESA Local Bus Motherboard
- Intel 80486DX-33 Processor
- 256K High-Speed Cache
- √ 8 Mb High-Speed RAM
- 32-Bit VESA Local Bus IDE Card
- √ 340 Mb IDE Hard Drive
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- 1.2 Mb 5.25" Floppy Drive
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- √ Diamond Stealth 24 VESA Local Bus SVGA Video Card
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- 7-Bay Full-Tower Case
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486DX2-66 $2559
#006340

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Elite 486SX/DX Notebooks

Enhance Your Images With Intel's "SL-Enhanced" Processors

For robust power management and long battery life, choose Elite 486SX/DX Notebooks featuring Intel's 486 "SL-Enhanced" microprocessors. Designed especially for portable computers, these chips support the system management mode (SMM) which lets power management software operate independently of the operating system. And because they have a static design, the clock signal can be slowed or stopped to conserve power.

Beyond power management, Intel's 486 "SL-Enhanced" processors are upgradeable to deliver the high-end processing speeds you'll need in the future. Choose between a 486SX-25, 486DX-33 or 486DX2-50 and feel confident that the Elite Notebook will meet your needs for years to come.

486SX/DX Notebooks are available with a 10" active-matrix color, dual-scan color or monochrome screen and up to a 340 Mb hard drive to capture your work in style. For maximum versatility they also come with a PCMCIA Type III slot which accepts two Type II cards or one Type III card. Swap modems, LAN, storage, or flash cards without powering down.

Order your 486SX/DX Notebook today and discover how Elite Notebooks raise computing to a fine art.

120 Mb	486SX-25	486DX-33	486DX2-50
Monochrome	005501 **$1599**	005516 **$1849**	005531 **$1999**
Dual-Scan Color	005506 **$2349**	005521 **$2599**	005536 **$2749**
Active-Matrix Color	005511 **$3199**	005526 **$3399**	005541 **$3599**

For an 80 Mb hard drive subtract $40. For a 200 Mb hard drive add $100.
For a 340 Mb hard drive add $280.

*Battery life measured with Power Management enabled. Actual battery life may vary.

Elements:

Processor:
Intel 486SX-25, 486DX-33 or 486DX-50 SL-Enhanced upgradeable processor

RAM:
4 Mb, expands to 20 Mb

Hard Drive:
80 Mb, 120 Mb, 200 Mb or 340 Mb

Screen:
10", 640 x 480 VGA resolution
Backlit display
Color - 256 colors
Monochrome - 64 gray shades

Battery Life*:
Active-Matrix Color - 3 hours
Dual-Scan Color - 4 hours
Monochrome - 6 hours

Weight:
Color - 6.9 lbs.
Monochrome - 6.4 lbs.

512K DRAM plus 64K VRAM for turbo bus accelerated video technology
Simultaneous video on active-matrix and monochrome models
86 keys with 101-key emulation
Built-in trackball
Built-in 1.44 Mb, 3.5" floppy drive
Advanced Power Management
One parallel and one serial port
External VGA and keyboard connectors
One PCMCIA Type III slot/ two Type II slots
FREE AC adapter and utilities disk
FREE MS-DOS 6.0 installed

Brilliant Ideas Require Brilliant Performance

Elite 486SX-25 SubNote

Illustrate Your Points On This 10" Screen

You'd think a small 3.9 lb. SubNote would be hard to work on—but it's not. Elite's 486SX-25 SubNote delivers 640 x 480 VGA resolution on its 10" high-contrast screen so you can illustrate charts and graphs that are easy to read.
And unlike other notebooks that leave your wrists hanging, the Elite SubNote offers a built-in trackball and extended palm rest to support wrists.

But, that's not all! The Elite SubNote receives rave reviews for its special Intel SL-Enhanced processor that conserves power and extends battery life up to five hours when combined with Advanced Power Management.

For extra power take advantage of the SubNote's PCMCIA Type II slot. It lets you insert credit-card sized PC cards for modems, flash memory, network adapters and more.

Get the picture? Now get the Elite 486SX-25 SubNote and get a whole new view of portable computing!

486SX-25 SubNote

Model	Item #	Price
80 Mb	005575	**$1499**
120 Mb	005576	**$1549**
200 Mb	005577	**$1639**
340 Mb	005578	**$1799**

Elements:

Processor:
Intel 486SX SL-Enhanced upgradeable processor
Processing Speed:
25 MHz
RAM:
4 Mb expands, to 12 Mb
Hard Drive:
80 Mb, 120 Mb, 200 Mb or 340 Mb
Screen:
10", 640 x 480 VGA resolution

Backlit display
64 gray shades
Battery Life*:
5 hours
Weight:
3.9 lbs.
512K DRAM plus 64K VRAM for turbo bus accelerated video technology
Simultaneous video
83 keys with 101-key emulation

Built-in trackball
External 1.44 Mb, 3.5" floppy drive
Advanced Power Management
Nickel metal hydride battery
One parallel and one serial port
External VGA and keyboard connectors
One PCMCIA Type II slot
FREE AC adapter and utilities disk
FREE MS-DOS 6.0 installed

Elite 486SLC-33 Color/Monochrome Notebook

a486 Notebooks At Starving Artist Prices

Get more power for your money with Elite 486SLC-33 Notebooks. Available in color or monochrome, these notebooks come with fast 33 MHz Cyrix processors, internal cache memory, and up to 8 Mb of RAM.

For maximum system flexibility, you can add an additional RAM module, a V.42bis internal fax modem or an external docking station.

Both models provide non-glare VGA screens that eliminate distortion, flickering and eye strain so you can compute comfortably. Text and graphics appear at 640 x 480 resolutions in 64 gray shades or an eye-catching 256 colors for graphic and spreadsheet applications.

And if you get caught up in your creative endeavors, a quick glance at the LCD panel lets you know which drives are being accessed, when battery power is low, what function keys are enabled, whether external power is being used and if there is a modem ring.

Affordably priced Elite 486SLC-33 Color/Monochrome Notebooks are a real work of art. Order yours today!

486SLC-33 Notebooks

Color

Model	Item #	Price
80 Mb	005461	**$1699**
120 Mb	005466	**$1769**
200 Mb	005471	**$1889**

Monochrome

Model	Item #	Price
80 Mb	005446	**$1209**
120 Mb	005451	**$1279**
200 Mb	005456	**$1399**

Elements:

Processor:
Cyrix 486SLC-33
Processing Speed:
33 MHz
RAM:
2 Mb RAM, expands to 8 Mb
Hard Drive:
80 Mb, 120 Mb or 200 Mb
Floppy Drive:
Built-in 1.44 Mb 3.5"
Screen:
Color - 9", 256 colors
Monochrome - 10", 64 gray shades
Video RAM:
Color - 512K
Monochrome - 256K

Keyboard:
83 key with 101-key emulation
2-button thumball mouse
Weight:
Color - 5.7 lbs. with battery
Monochrome - 5.4 lbs. with battery
Battery Life*:
Color - 4 hours
Monochrome - 6 hours
640 x 480 resolution
Simultaneous video
Advanced Power Management
One parallel and one serial interface
External VGA monitor and keyboard connectors
FREE AC adapter carrying case and MS-DOS 6.0 installed
One year manufacturer's warranty

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*Battery life measured with Power Management enabled. Actual battery life may vary.

AD#G1103

CIRCLE 398 ON READER SERVICE CARD

from the Mac to the PC. While not as convenient as reading Mac files directly, a null-modem serial connection is an appropriate choice for one-time or occasional file transfer between a PC and a Mac. Programs like LapLink Mac ($149.95, Traveling Software, 206-483-8088) must be running on both the PC and the Mac simultaneously in order to complete the file transfer. Unfortunately, LapLink Mac's minimum requirements include a Mac Plus, 300K of available RAM, and System 5.0—which preclude it as a solution for your original 128K Macintosh system.

For your particular mix of hardware, consider a product like MatchMaker ($149, Micro Solutions Computer Products, 815-756-3411). MatchMaker is a controller board that fits into any ISA or EISA slot and allows your PC to operate an external Mac floppy disk drive. The advantage is that you can read any Mac disk format the external drive supports; the disadvantage is that you must purchase an external drive. But if you need to convert a large number of files, this approach may prove cost-effective in the long run.—*Luisa Simone*

Networking

EQUIPMENT FOR SWITCHED 56 SERVICES

❓ I'm confused about how you use Switched 56 digital services. I know you don't use a modem, but what kind of equipment do you use and how much does it all cost?

Bill Drugan
Chicago, Illinois

▶**PC MAGAZINE:** Unfortunately we seem to be stuck using the imposing but arcane technical term CSU/DSU (channel service unit/data service unit) to describe the equipment that connects a computer to a Switched 56 digital line. The channel unit is the Switched 56 telephone line and the data unit is the serial port, but everything is actually in one box. Obviously, we could use a better term.

A modern CSU/DSU for Switched 56 service is an interface device that looks and acts very much like an analog modem. It connects to a PC or a router through a serial cable (typically using the V.35 serial specification instead of the less robust RS-232 specification), connects to a wall jack using regular modular telephone plugs and wire, and dials calls in response to AT commands received over the serial line. A CSU/DSU costs more than a modem, but it moves data in digital form on both the serial line and the telephone line.

While the V.35 serial interface is common on routers, getting a V.35 port in a PC presents a problem. Eicon Technology in Montreal (514-631-2592; fax, 514-631-3092) markets a Dual-Port Network Adapter (DPNA/PC) that gives a PC the ability speak V.35 as well as many higher-level protocols such as X.25 and Frame Relay, but its $1,595 price tag can knock the cost advantage of Switched 56 for a loop!

A null-modem serial connection is an appropriate choice for occasional file transfer between a PC and a Mac.

Integrated Network Corp., (INC) in New Jersey, (908-218-1600; fax, 908-218-0804) markets its CM-2056 family of Switched 56 CSU/DSU products that can optionally use V.35 or asynchronous RS-232. These devices have internal diagnostics, options for network management, an LED screen, and all of the features found in high-end modems from AT&T, CODEX, and UDS. The configured price is $1,395, but you do get everything you need to connect a PC to a Switched 56 outlet.

If you expect to use a PC's serial port at 57.6 kilobits per second to receive data, you should invest in a buffered serial-port card. The Hayes ESP board, MultiTech ISI502, Telcor Systems' T/Port, and the Digiboard PC/2e each fill the bill. Prices range from $199 for the Telcor to $299 for the Digiboard, Hayes, and MultiTech products, although the street prices are much closer together. One nice feature of processor-equipped serial boards is that all of the ports use the same interrupt, so you have more IRQ options left over for LAN adapters, sound boards, and other devices.—*Frank J. Derfler, Jr.*

SERVICING MANY PRINTERS FROM ONE SERVER

❓ Our legal office puts out a *lot* of letters. We figured out that it's more cost-effective to buy additional lower-cost laser printers than it is to buy one faster printer with a higher price tag. But we've run into problems trying to put several printers on a single server. How can we attach six printers to one server?

Bill Donohue
Norcross, Georgia

▶**PC MAGAZINE:** Protec in Quebec (514-630-5832; fax, 514-694-6973) offers the $795 NetAdvantage PSC board that can connect the parallel ports of four printers to a server, and you can install up to four NetAdvantage PSC boards in one server. The boards also have the useful ability to drive printers up to 200 feet away. —*Frank J. Derfler, Jr.*

Languages

A TURBO VISION METER CONTROL

✓TIP I've been using Turbo Vision with Turbo Pascal for a while, and I like most of it. One thing it lacks, however, is some kind of an object that visually displays the progress of a time-consuming process—for example, a file-copying, -verification, or -conversion process.

I liked the meter controls used in many CUA-compliant utilities and applications that display a thermometer-style meter from 0 to 100 percent and fill it to whatever degree the operation has completed. I decided that I needed that kind of control in my Turbo Vision programs, too. So I sat down to program, and the result was the unit METER (Figure 2).

I think the code should be pretty self-explanatory, and the unit is short enough

Tom & Tom

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Symmetrical Multiprocessing or SMP allows two processors to work simultaneously. When two people share a job it's easier, faster, and a lot more gets done. The same is true with two processors working simultaneously. The VTech Platinum™ SMP computer, together with Windows NT, enables two processors to divide tasks between them. Like a two lane highway that suddenly becomes four lanes, processing flows with greater ease and efficiency. Two processors yielding twice the performance and power of traditional single processor PCs.

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No other competitor gives you the expandability options that VTech does. *When we say expandable, we mean expandable.* No more worrying about the specter of obsolescence. Each VTech Platinum™ SMP computer gives you the highest level of performance in Intel 486 based technology today while being user upgradable in the future with the Pentium™ OverDrive™ processor.

But more importantly, you can upgrade today, right now, immediately, when you need the muscle of multiprocessing. By adding a second processor board, along with the enabling software, your single processor system is transformed into a symmetrical multiprocessing system yielding twice the performance and power.

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Starting with a single Intel 486DX2/50 or an Intel 486DX2/66 you can expand to double the power by adding a second processor board. Simply slip in the optional SMP Power Card and you're ready to fly. And when the OverDrive™ ready processor is released you can double that performance too! *The future is just waiting for you!*

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The VTech Platinum™ SMP computers offer the latest in advanced technology. VESA local bus, two cooling fans, copy-back cache, self sensing set-up, mix and match SIMM configuration, SCSI-II, and Intel standard multiprocessing implemintation, are just a few of the performance enhancing features already built-in. Shown is the VTech Platinum™ SMP 486DX2/66² Dual Processor.

	VTech SMP 486DX2/50 single	VTech SMP 486DX2/66 single	VTech SMP 486DX2/66 single	VTech SMP 486DX2/66² dual
Price	$2299.	$2499.	$2999.	$3999.
Intel 486dDX2/50 Processor with 256K Cache	■			
Intel 486DX2/66 Processor with 256K Cache		■	■	
2 Intel 486DX2/66 Processors with 256K Cache				■
VESA Accelerated Local Bus	■	■	■	■
S3 Windows Accelerator Video Card with 1Mb RAM	■	■	■	■
8 Meg System RAM	■	■		
16 Meg System RAM			■	■
3.5" Disk Drive	■	■	■	■
340 Meg Hard Drive	■	■		
527 Meg Hard Drive			■	■
Dual Speed CD ROM			■	■
15" Non-Interlaced Monitor	■	■	■	■
MP Dual Processor Power Card				■
MS DOS 6.0, Windows 3.1, Hi-Res Mouse	■	■	■	
Windows NT and Hi-Res Mouse				■

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intel inside

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Research and development, too, is ongoing in three laboratories.

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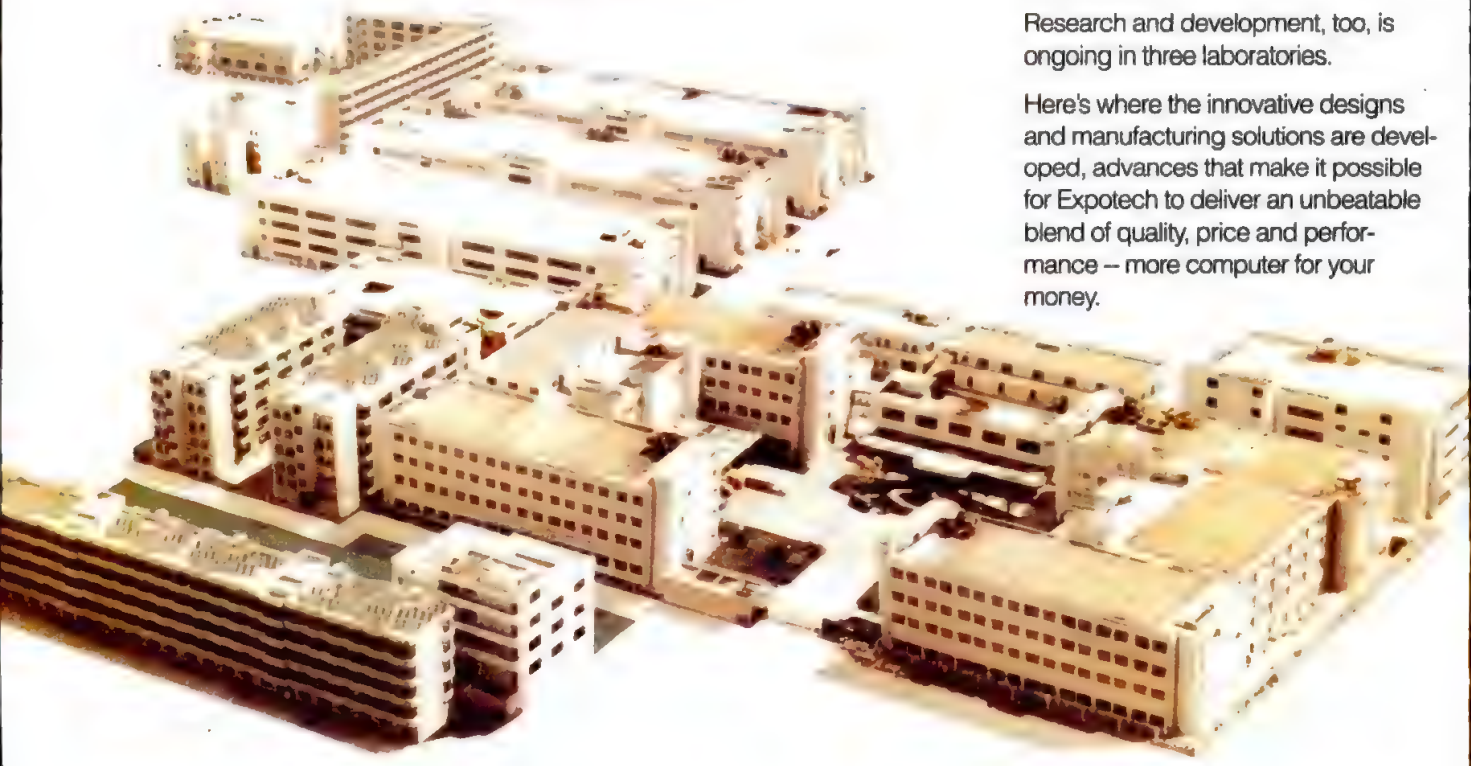

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es" answers in the comparison chart tell the most convincing story about tech value. Check it out for yourself. npare feature for feature, service for a. No one offers a more comprehen- ecurity and service package. But it's at you'd expect from a multi-national npany determined to accelerate its You can only do that by beating tition. And you can only do *that* ing customers. We have, over a million so far.

SERVICE FEATURE	oxo tech	DELL	GATEWAY	ZEOS	compaq prolinea	IBM Value Point
3 YEAR WARRANTY	YES				YES	
REMOTE DIAGNOSTICS	YES				OPTIONAL	
24 HOUR TECH SUPPORT	YES			YES	YES	YES
FREE ON SITE SERVICE	YES	YES	YES		YES	YES
OPEN 7 DAYS / WEEK	YES	YES		YES		
EXPRESS PARTS SERVICE	YES	YES	YES	YES		
FAX TECHNICAL ADVICE	YES	YES	YES	YES		
SAME DAY SERVICE	YES	YES	YES	YES		
SYSTEM FEATURE						
ANTI VIRUS SOFTWARE	YES					
FREE FAX/ MODEM	YES					
SERVICE VALUE RATING PC COMPUTING AUG. 1993	★★★★★★	★★★★★★	★★★★★★	★★★★★★	★★★★★★	★★★★★★

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- 102 Key Keyboard
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- MS-DOS 6.0, Windows 3.1, Hi-Res Mouse
- Commute Remote Diagnostic Software
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- 2400 Baud Modem w/Send-Receive Fax
- 4 Mb RAM, 340 Meg Seagate Hard Drive

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METER.PAS

Complete Listing

```
{$X+,V-}
UNIT Meter;
(**) INTERFACE (**)
USES Dialogs, Drivers, Objects, Views;
TYPE
  PMeter = ^TMeter;
  TMeter = OBJECT(TView)
    low, high,   (* low and high limit of values      *)
    meterlen,    (* length of the meter display       *)
    currperc,    (* current percentage of completion *)
    currfilled,  (* currently filled boxes            *)
    TxColor,     (* Colors for Text and Meter         *)
    MtColor      : WORD;
    theMsg       : PString; (* string to display w/ meter *)
    (* constructor initializes the meter control and
       sets low/high values and the message; warning:
       the rectangle 'R' needs to be exactly 2 rows
       high and at least 10 columns wide *)
    CONSTRUCTOR Init(R : TRect; Message : STRING;
                     lowbound, highbound : WORD);
    DESTRUCTOR  Done; VIRTUAL;
    PROCEDURE Draw; VIRTUAL;
    (* set a given value to be used in the display;
       the meter control calculates the current percentage
       and the number of boxes to be filled and redraws
       the control, if there's been a change *)
    PROCEDURE SetValue(value: WORD);
        (* set the colors for the text and meter control *)
    PROCEDURE SetColor(TextColor, MeterColor : WORD);
  END;
(**) IMPLEMENTATION (**)
CONSTRUCTOR TMeter.Init(R : TRect; Message : STRING;
                        lowbound, highbound : WORD);
BEGIN
  (* check if rectangle is big enough to hold meter control *)
  IF(R.B.Y - R.A.Y <> 2) OR (R.B.X - R.A.X < 10) THEN FAIL;
  TView.Init(R);
  Options    := Options AND (NOT ofSelectable) AND (NOT ofTileable)
                        AND (NOT ofFramed);
  GrowMode   := 0;
  State      := State AND NOT sfShadow;
  (* calculate meter length and set default values *)
  meterlen   := R.B.X - R.A.X - 1;
  currfilled := 0;
  currperc   := 0;
  low        := lowbound;
  high       := highbound;
  (* initialize message *)
  theMsg     := NewStr(Message);
  (* get default colors *)
  TxColor := $70;
  MtColor := $7F;
END;

DESTRUCTOR TMeter.Done;
BEGIN
  DisposeStr(theMsg);
  TView.Done;
END;

PROCEDURE TMeter.Draw;
 (* Draw method; fills two string buffers, one
   with the message and the currently achieved
   percentage, the other one with the actual meter
   with partly unfulfilled and partly filled "boxes" *)
VAR
  percstr : STRING;
  B       : TDrawBuffer;
BEGIN
  (* fill first string buffer *)
  MoveChar(B, ' ', TxColor, Size.X);
  MoveStr(B[1], TheMsg^, TxColor);
  Str(currperc:3, percstr);
  MoveStr(B[meterlen-3], percstr, TxColor);
  MoveStr(B[meterlen], '%', TxColor);
  WriteLine(0, 0, Size.X, 1, B);
  (* fill second string buffer *)
  MoveChar(B, ' ', TxColor, Size.X);
  IF currfilled <= meterlen THEN
    BEGIN
      MoveChar(B[1], #219, MtColor, currfilled);
      MoveChar(B[currfilled+1], #176, MtColor,
        meterlen-currfilled+1);
    END
  ELSE MoveChar(B[1], #219, MtColor, meterlen);
  WriteLine(0, 1, Size.X, 1, B);
END;

PROCEDURE TMeter.SetValue(value: WORD);
 (* set the new value; we then calculate the new
   percentage and number of filled boxes to be
   drawn, and redraw the view *)
VAR perc : REAL;
BEGIN
  IF (value < low) OR (value > high) THEN Exit;
  perc := (value-low)/(high - low);
  currperc := WORD(Round(perc*100.0));
  currfilled := WORD(Round(perc*meterlen));
  DrawView;
END;

PROCEDURE TMeter.SetColor(TextColor, MeterColor : WORD);
BEGIN
  TxColor := TextColor;
  MtColor := MeterColor;
END;

END.
```

Figure 2: **This Borland Pascal unit implements a meter control for displaying the progress of a given task in a Turbo Vision application.**

TESTMETR.PAS

1 of 2

```
{$X+,V-}
PROGRAM TestMetr;
USES App, Crt, Dialogs, Drivers, Menus, Objects, Views,
     Meter;
CONST
  cmMeterDemo   = 100;
TYPE
  TMyApp = OBJECT(TApplication)
   (* overriden methods *)
    PROCEDURE HandleEvent(VAR Event: TEvent);  VIRTUAL;
    PROCEDURE InitMenuBar;                     VIRTUAL;
    PROCEDURE InitStatusLine;                  VIRTUAL;
   (* new methods *)
    PROCEDURE ShowMeter;
  END;

PROCEDURE TMyApp.HandleEvent(VAR Event: TEvent);
BEGIN
  TApplication.HandleEvent(Event);
  IF Event.What = evCommand THEN
    BEGIN
      CASE Event.Command OF
        cmMeterDemo : ShowMeter;
        ELSE EXIT
      END;
      ClearEvent(Event);
    END;
END;

PROCEDURE TMyApp.InitMenuBar;
VAR R: TRect;
BEGIN
  GetExtent(R);
  R.B.Y := R.A.Y + 1;
  MenuBar :=
    New(PMenuBar, Init(R, NewMenu(
      NewSubMenu('~F~ile', hcNoContext, NewMenu(
        NewItem('~M~eter control demo', 'F2', kbF2,
                    cmMeterDemo, hcNoContext,
        NewLine(
        NewItem('E~x~it', 'Alt-X', kbAltX, cmQuit, hcNoContext,
        NIL))))),
      NIL)
    )));
END;

PROCEDURE TMyApp.InitStatusLine;
VAR R: TRect;
BEGIN
  GetExtent(R);
  R.A.Y := R.B.Y - 1;
  StatusLine :=
    New(PStatusLine, Init(R,
      NewStatusDef(0, $FFFF,
        NewStatusKey('~Alt-X~ Exit', kbAltX, cmQuit,
        NewStatusKey('~F2~ Demo for meter control',
                        kbF2, cmMeterDemo,
        NIL)),
      NIL)
    ));
END;

PROCEDURE TMyApp.ShowMeter;
(* demo procedure showing three different meter controls *)
VAR
  PM, PM2, PM3 : PMeter;
  PD : PDialog;
  i  : WORD;
```

Figure 3: **TESTMETR.PAS demonstrates the meter control implemented in Figure 2; run it and press F2 to see the demonstration.**

TESTMETR.PAS
2 of 2

```
  R  : TRect;
BEGIN
  R.Assign(25, 4, 55, 16);
  PD := New(PDialog, Init(R, 'Meter Demo Dialog'));
  Desktop^.Insert(PD);
 (* first meter, pretending some copying operation *)
  R.Assign(2, 2, 25, 4);
  PM := New(PMeter, Init(R, 'Copying...', 0, 250));
  PD^.Insert(PM);
 (* second meter, indicating some verification process *)
  R.Move(0, 3);
  PM2 := New(PMeter, Init(R, 'Verifying...', 100, 200));
  PM2^.SetColor($74, $2E);
  PD^.Insert(PM2);
 (* last meter shows some kind of conversion action *)
  R.Move(0, 3);
  PM3 := New(PMeter, Init(R, 'Converting...', 0, 300));
  PM3^.SetColor($71, $1A);
  PD^.Insert(PM3);
  FOR i := 1 TO 250 DO
    BEGIN
      PM^.SetValue(i);
      Delay(25);
    END
  FOR i := 100 TO 200 DO
    BEGIN
      PM2^.SetValue(i);
      Delay(10);
    END;
  FOR i := 1 TO 300 DO
    BEGIN
      PM3^.SetValue(i);
      Delay(25);
    END;
  Delay(1000);
  Desktop^.Delete(PD);
  Dispose(PD, Done);
end;

VAR  MyApp : TMyApp;
begin
  MyApp.Init;
  MyApp.Run;
  MyApp.Done;
END
```

to be quite easily understood. I also included a short Turbo Vision skeleton application (Figure 3) that shows how to use meter controls.

Mark Scheuner
Burgdorf, Switzerland

▶**PC MAGAZINE:** The TMeter control implemented in METER.PAS is quite easy to use. Just insert it in a dialog box, set the colors if the default doesn't suit you, and call its SetValue method any time the value it's tracking changes. The programmer is responsible for sending only values that fall between the low and high bounds for the control.

The example dialog box can't be closed until all three meters have reached 100 percent, at which time it closes *itself*. This is typical of the kind of application you'll use a meter for—a fairly long process that needs to be completed before anything else can happen.

You can download METER.PAS and TESTMETR.PAS from PC MagNet's Programming Forum, archived as METER.ZIP.—*Neil J. Rubenking* □

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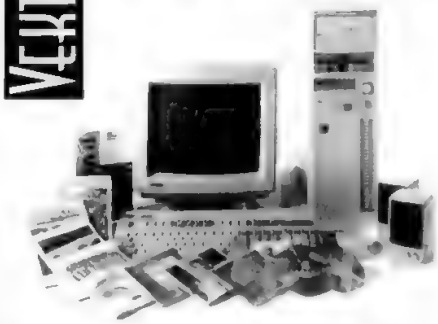

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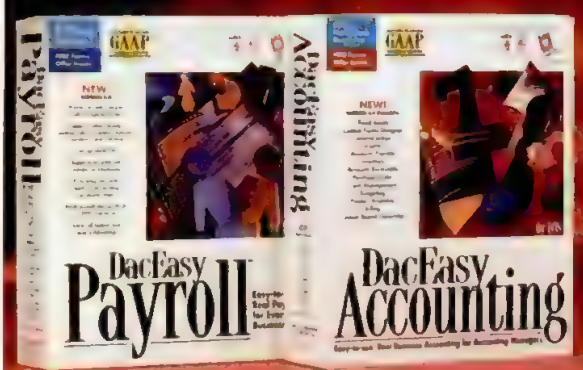

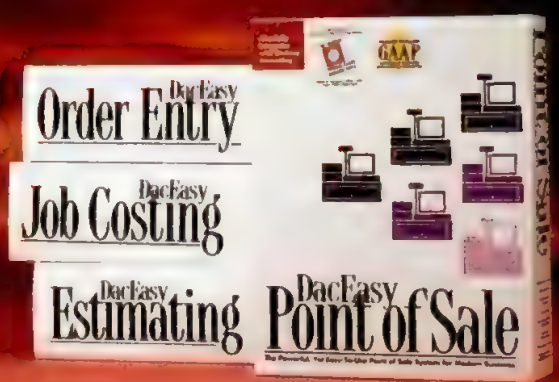

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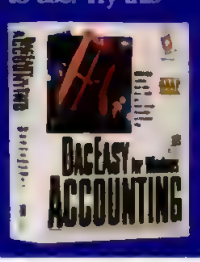

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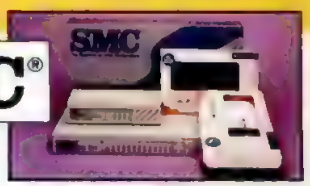

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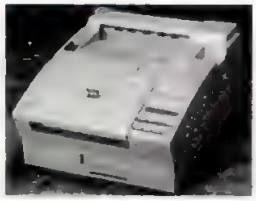

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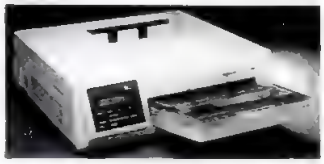

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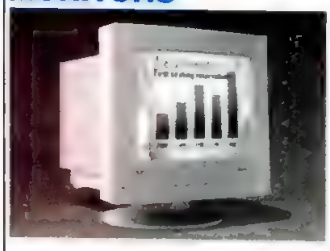

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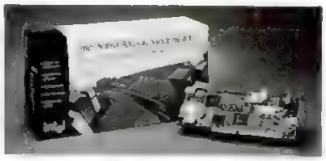

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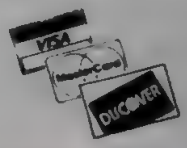

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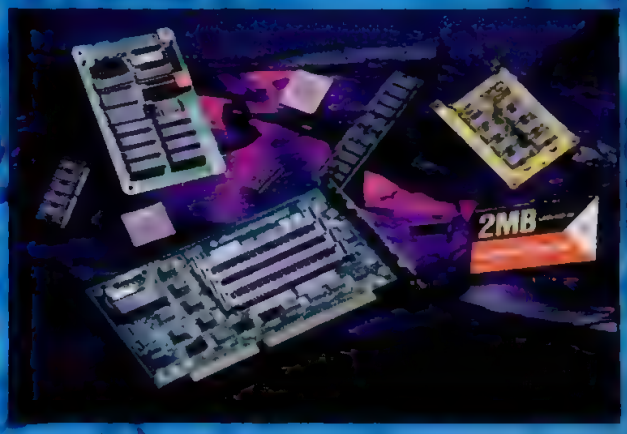

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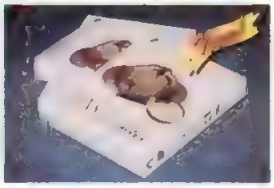

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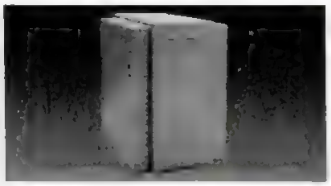

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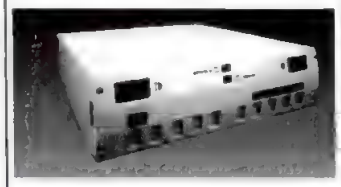

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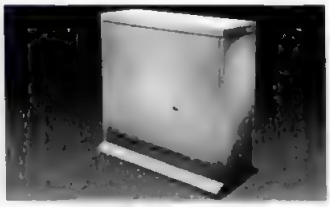

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CP30344	340	1"	12	$ 303
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8MB $589
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PowerExec 3/25SL, 3/25SL-C, EL
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16MB $1279
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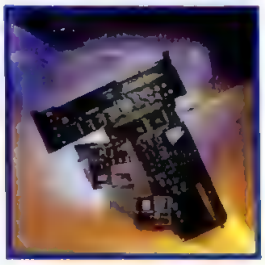

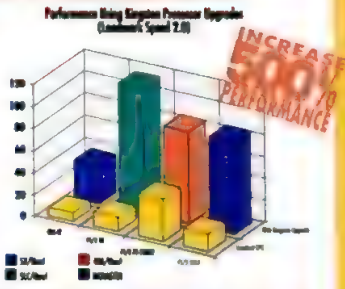

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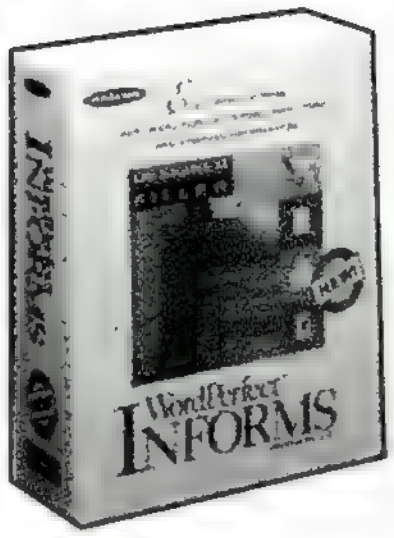

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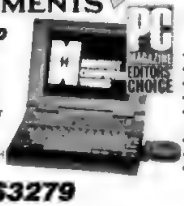

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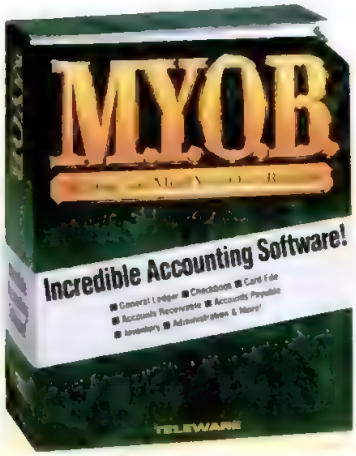

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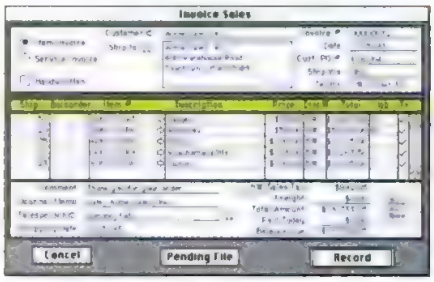

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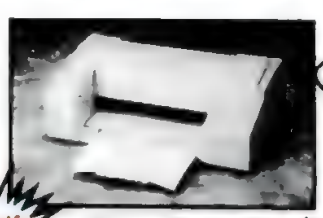

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HP 3SI	–	–	49	–	–	–	139	–	–	309	–	–
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NEC 90, 290	–	–	–	109	–	–	–	–	–	–	–	–
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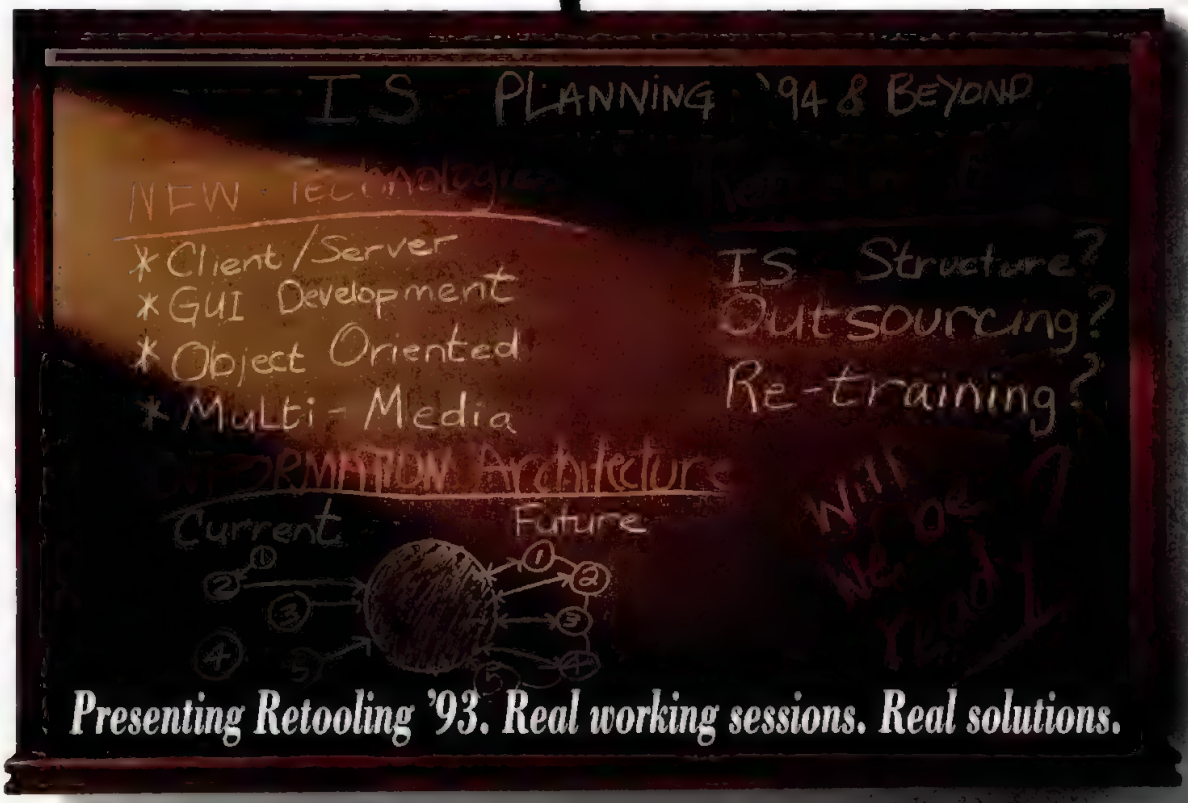

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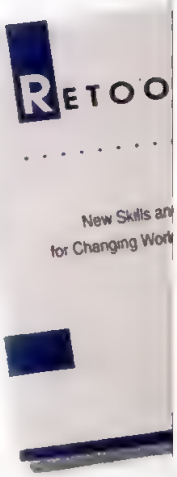

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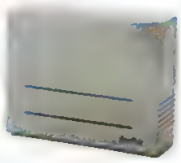

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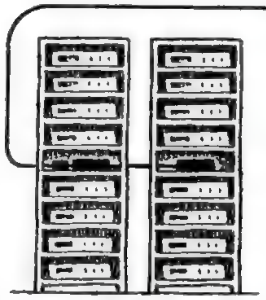

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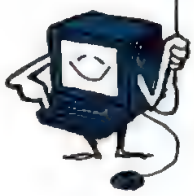

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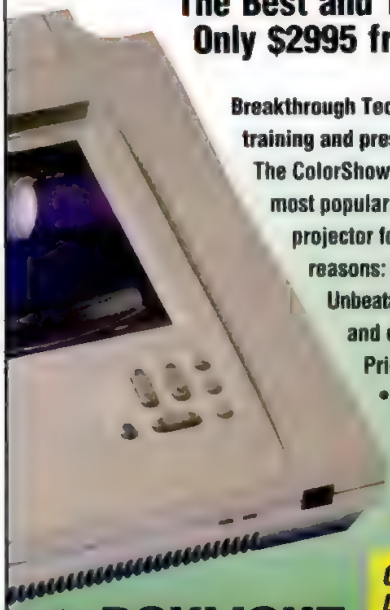

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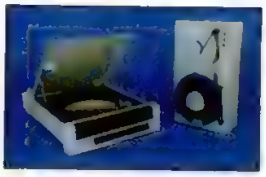

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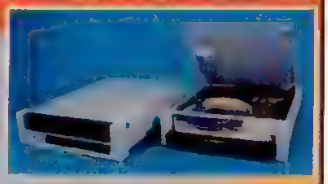

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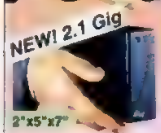

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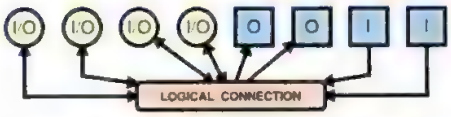

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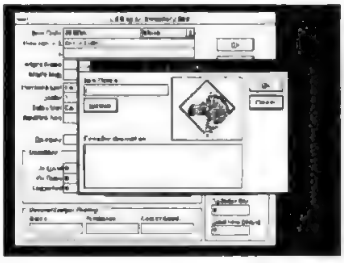

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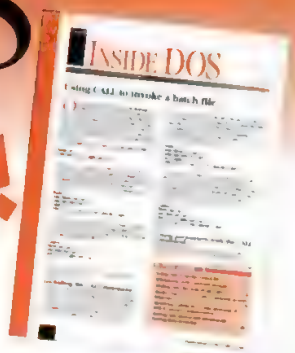

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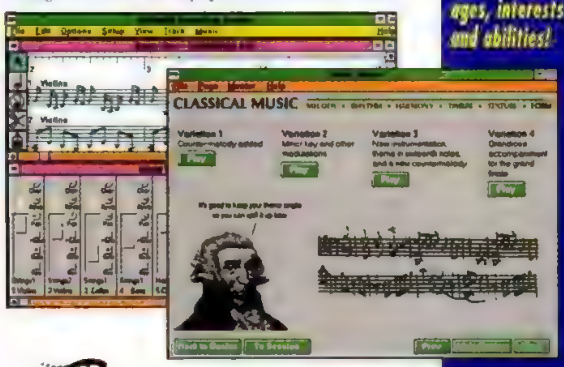

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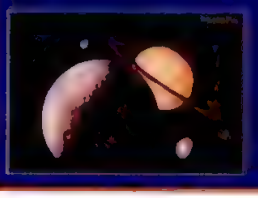

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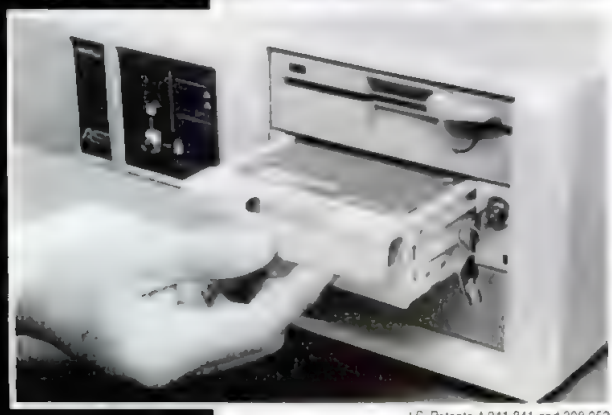

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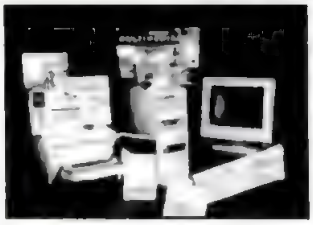

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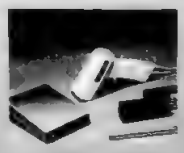

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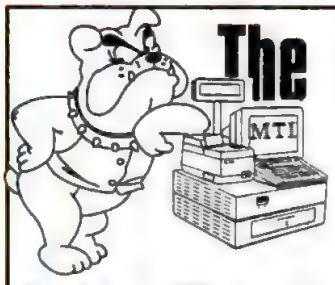

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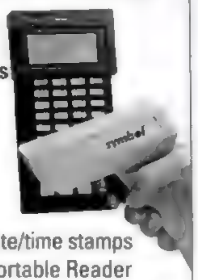

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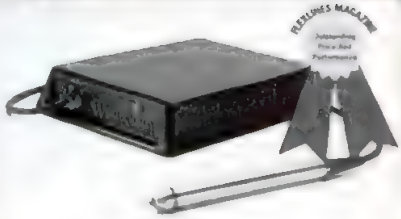

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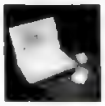

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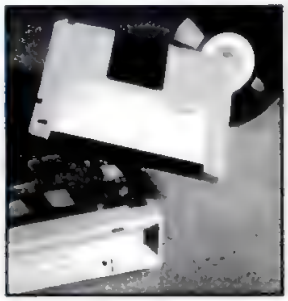

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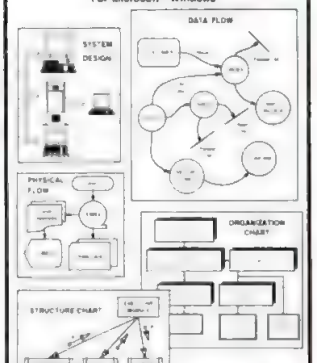

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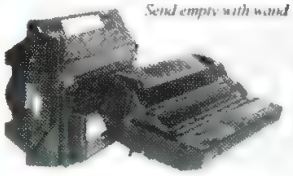
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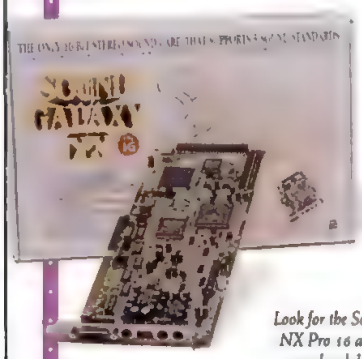

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PC MAGAZINE

Coming Up

Word Processors

Will word processors *ever* stop growing? Well, not this season. *PC Magazine* will review the fall '93 crop of eight full-featured text tweakers—an evenly balanced field that includes DOS, Windows, and OS/2 players—and preview three next-generation products. Tune in for dramatic developments, such as full WYSIWYG graphical editing in a DOS environment, sound, and unlimited undo.

PCI Bus Arrives

The PCI local bus is coming soon to a PC near you, and with it comes the promise of smooth, rich-color, full-motion video, faster hard-disk access, and the ability to exploit the Pentium processor fully. Will the PCI specification unseat VL-Bus as *the* local-bus standard, or will PCI follow in the footsteps of the EISA and Micro Channel architecture standards and fail to win a large following? *PC Magazine* takes a close look at the future potential and current reality of PCI technology.

Portable Documents

With the way we communicate rapidly changing, it's more important than ever to be able to share information across different platforms. The push is on to make the Standard Generalized Markup Language (SGML) the standard means for cross-platform document exchange, with several companies taking advantage of the opportunity to be part of the action. We examine the technology that may be a harbinger of things to come in the information age.

SQL Front-End Development Tools

The latest wave of GUI front-end development tools lets you harness the full power of SQL database servers at the client PC. We test six Windows and OS/2 products to show how they stack up in SQL query generation, transaction processing, report writing, and connectivity. We also look at simpler, nonprogrammable front ends that can empower end users who don't know a line of SQL.

Free Utility

Device drivers give DOS a convenient way to support a wide variety of peripheral devices. But having to edit your CONFIG.SYS file and reboot each time you add a driver is anything but convenient. Now you can get instant flexibility with DRVLOAD, this issue's free utility that lets you load a device driver right from the DOS command prompt.

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After Hours

CHILDREN'S SOFTWARE: EA*Kids Theater; Eagle Eye Mysteries; Scooter's Magic Castle; Ping and Kooky's Cuckoo Zoo; Where in Space is Carmen Sandiego? Deluxe; Lost Secret of the Rain Forest

CHILDREN'S SOFTWARE

New EA*Kids Line Debuts, Two Old Favorites Return

BY CHARLES TAFT

When a vendor wants a strong presence in a category, it often introduces a whole line, not just a product or two. Such was the case when Electronic Arts introduced its EA*Kids line. With three titles available simultaneously and more titles expected in time for Christmas, EA*Kids has made its presence known. In this review of children's software, we look at the new line and take you back to two old favorites: Lost Secret of the Rain Forest (the latest in Sierra On-Line's delightful EcoQuest series) and Where in Space is Carmen Sandiego? Deluxe (starring every kid's favorite super thief, now wreaking havoc in space).

EA*KIDS

EA*Kids Theater

Electronic Arts' foray into the world of children's software begins with a menu interface that makes getting to each game easy and fun. The colorful Theater, included in each of the EA*Kids programs, comes complete with a marquee with multicolored blinking lights, posters of the games loaded on your system, and posters of previews of coming attractions—games you don't own, as well as soon-to-be-released EA*Kids programs.

To play a game, click on its poster: The Theater launches the program and returns you to the Theater when you're finished. The Theater is equipped with a control panel that offers helpful information on viewing programs and previews, installing new EA*Kids programs, or selecting background music.

The three current features are Eagle Eye Mysteries, Scooter's Magic Castle, and Ping and Kooky's Cuckoo Zoo. Peter Pan: A Story-Painting Adventure (an interactive storybook for users ages six to ten) and Video Jam (an animated music-video program for ages eight and up) are listed as coming attractions.

EA*Kids games don't require this nifty front end, but it's on the first disk of each of the games reviewed here. One can easily launch the games from the DOS prompt, though EA doesn't recommend launching the games from Microsoft Windows.

NIFTY FRONT END: EA*Kids Theater uses a movie theme to display Electronic Arts' children's games.

EA*KIDS

Eagle Eye Mysteries

Teenagers Jake and Jennifer Eagle run the Eagle Eye Detective Agency in Richview, USA. They're inviting children, ages eight and up, to help solve the 56 cases in Eagle Eye Mysteries.

Cases reflect certain favorite themes for kids: among the tasks, recover a stolen skateboard, determine the authenticity of a collectible baseball card, and research whether a skeleton found in Richview is a prehistoric find or a simple hoax.

GATHERING CLUES: In Eagle Eye Mysteries, Jake Eagle questions a local resident to solve the case.

Detective assignments come in a number of ways: Friends visit Eagle Eye headquarters and ask for help, or townspeople call when they need assistance. Players then choose Jake or Jennifer Eagle as their partner and begin the investigation.

Like all good detectives, Jake and Jennifer encourage kids to follow the basic steps of sleuthing: gathering clues by talking to witnesses and examining the crime scene, analyzing the clues, and, finally, accusing the suspect. As is fairly standard in games of this nature, information is stored in the Eagles' handheld computer—in this instance, TRAVIS (Text Retrieval And Video Input System).

To begin each case, players receive a highlighted map of Richview. Kids then travel to the highlighted area—the Richview Mall or the Public Library, for example—to search for clues. Once a player arrives at a site, relevant suspects and objects are highlighted on the screen.

The suspects themselves can be any of Richview's residents; these characters—an ensemble cast of sorts—appear again and again, but they don't always keep their personas. A person who helps out in one case could be the one causing trouble in another.

When all the witnesses have been interviewed, it's time to form a hypothesis and accuse a suspect. Players who do their sleuthing correctly are rewarded: the perpetrator

confesses, and the Richview Courier newspaper provides a writeup. If players are wrong or haven't picked the strongest clues needed to substantiate the accusation, they're asked to rethink the evidence and then identify a suspect.

The game is fun to play. Although it's geared for a single player, some children like forming a team with their friends to solve the on-screen capers. The clues are challenging, and there are many red herrings to throw the young gumshoe off track.

Eagle Eye Mysteries offers cases in three levels of difficulty; there are 25 cases in each of the first two levels and six cases in level three. The user's manual is clearly written; there's also a practice session to help players become accustomed to the game's procedures. An accompanying activity book offers challenging projects and an opportunity for children to complete a puzzle and win a chance to star in the sequel to Eagle Eye Mysteries.

Eagle Eye Mysteries, *$49.95.* Requires: *640K RAM, DOS 3.3 or later, 10MB hard disk space; sound card recommended. EA*Kids (a division of Electronic Arts), 1450 Fashion Island Blvd., San Mateo, CA 94404; 415-571-7171, 800-245-4525; fax, 415-513-7465.*

Circle 488 on reader service card

EA*KIDS

Scooter's Magic Castle

Scooter's Magic Castle is three stories high and packed with entertainment. Designed for five- to eight-year-olds, the 25 activities in this program challenge memory, teach vocabulary and spelling skills, reinforce patterning skills, and let kids have fun.

Scooter, a friendly, elf-like creature, and his pal, Theo the Owl, accompany children as they explore the castle. Kids can wander the passageways on their own or pick a destination from a pull-down menu. This castle is filled with challenging activities, colorful graphics, and surprises.

MIX AND MATCH: Kids match the objects to their shadows before the Wizard wakes up.

MAGIC EVERYWHERE

Young players will enjoy discovering the secrets that lie behind the castle's trap doors and revolving walls. Touch Scooter's magic wand to the still-life painting of fruit, for example, and the fruits come to life and start laughing.

The real action, however, takes place in the chambers. Creativity tools let kids experiment with music, art, and even gardening; logic and memory games are challenging and offer rewards when children complete them. In Noisy Stairs, for example, children must play the same tones the program does. When they successfully complete the exercise, the stairs turn into a ramp; Scooter slides up and performs acrobatic tricks.

The program enables players to choose from three levels of difficulty and to switch levels whenever they choose. In the Wizard's Chamber, for example, children must place each object in the room next to its shadow before the Wizard wakes up. Depending on the level of difficulty, there are 6, 10, or 15 objects to match.

Like the other EA*Kids games, Scooter's Magic Castle is supportive and nonthreatening. Scooter and Theo are engaging characters, and children can use the program without their parents' help.

Scooter's Magic Castle, *$49.95.* Requires: *640K RAM, 10MB hard disk space, DOS 3.3 or later; mouse and sound card recommended. EA*Kids (a division of Electronic Arts), 1450 Fashion Island Blvd., San Mateo, CA 94404; 415-571-7171, 800-245-4525; fax, 415-513-7465.*

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EA*KIDS

Ping and Kooky's Cuckoo Zoo

Ping Panda and Kooky Cuckoo's train ride through Cuckoo Zoo may be more entertainment than education, but that's probably the right mix for many three- to six-year-olds who take this imaginary ride. In Cuckoo Zoo, the youngest computer users can stop along the way, meet their animal friends, and join them in activities designed just for them.

FUN FOR TOTS: The youngest computer users can help Ping Panda select the right tail for the cow.

The fun takes place in four regions of Cuckoo Zoo: the Savannah, the Rain Forest, The Farm in the Zoo, and Polar Park. Here, children play games with the indigenous animals or ask Kooky to mix up the animals' bodies and unscramble them. Success is rewarded by lively animations.

Each region uses its native animals to teach different skills. In the Savannah, which features Ping Panda's Paint the Animals game, players learn the names of various colors. Children learn the alphabet in Maggie Monkey's Flying Alphabet game, found in the Rain Forest region. On the Farm in the Zoo, children play Hide and Seek with barnyard animals, and in Polar Park, children practice simple addition with Walter Walrus.

Besides these four areas, EA*Kids supplies a creativity tool, Cuckoofest, a musical show that features all the animals and lets kids create and play their own songs.

Children or their parents can select one of three levels of difficulty for the activities; at any time during an activity, children may choose another activity and go there immediately. The program offers substantial voice narration for pre-readers to enable them to play the activities. With these

features, preschoolers will find Cuckoo Zoo easy to use, and parents will have a good way to introduce their young ones to PCs.

Ping and Kooky's Cuckoo Zoo, *$49.95.* Requires: *640K RAM, DOS 3.0 or later, 14MB hard disk space; mouse and sound card recommended. EA*Kids (a division of Electronic Arts), 1450 Fashion Island Blvd., San Mateo, CA 94404; 415-571-7171, 800-245-4525; fax, 415-513-7465.*

Circle 488 on reader service card

BRODERBUND SOFTWARE

Where in Space is Carmen Sandiego? Deluxe

Broderbund Software's latest adventure is out of this world. Where in Space is Carmen Sandiego? Deluxe takes Acme Detectives, ages eight and up, on a merry chase through the galaxy.

Dedicated Carmen chasers will immediately notice the slightly different look and feel of this latest Carmen Sandiego adventure. To bring Carmen into the space age, Broderbund made several changes. The straitlaced Chief has been replaced by an animated alien creature whose words are translated on screen; the Chronoskimmer has become the Cosmohopper 911 Turbo space ship; instead of V.I.L.E. henchpeople, there are now 14 alien "henchthings" (including the four-armed, six-eyed, bat-winged Hanover Fist and the one-eyed, web-handed fish, Enzo di Galaxi) helping Carmen steal objects and create pandemonium.

Last, the hard-copy reference manuals have been replaced by a wisecracking onboard computer and database, the Val 9000, that has an unusual sense of humor, to say the least.

In other cases, Broderbund has stuck to its roots. The program's graphics, for example, maintain the delightful combination of more than 50 digitized photographs (including many from NASA) and animated cartoon characters and backgrounds. The digitized NASA photographs and accompanying music are breathtaking—almost like having a planetarium in the computer.

As always, the company has imbued Carmen with a punny sense of humor (for instance, the asteroid that holds the criminals is called Jailhouse Rock), and, of course, a warrant is always required for an arrest.

To obtain the warrant, players must gather evidence. To do so, they can question witnesses, tap V.I.L.E. encoded frequencies and listen to messages, conduct a star search (using latitudinal and longitudinal coordinates), contact informants (and use the program's built-in translator to decipher their statements), and launch probes to gather more information and apprehend the suspects.

SPACE DATABASE: Carmen Sandiego's Val 9000 holds facts and photos of all the planets, including Earth.

The program offers detectives four ways to gather information from the viewport window of the Cosmohopper: Kids can access the Val 9000 database, project the Travel Map and select the next search location, display an Orbital View of their current location, or choose the Star Map and display 88 constellations.

The Val 9000 database interface is easy to use. First, users choose from one of 18 subject headings; next, depending on the selection, they choose among subtopics. The Astronomers topic, for example, has pictures and biographies of 12 famous astronomers, including Galileo Galilei and Edwin Hubble.

Users can even investigate some manned and unmanned space trips; the Explorations menu lists significant missions in both categories. In the unmanned missions section, there are two simulations of actual space explorations. The more impressive of these is a computer-generated animation that uses actual Viking photographs to simulate the Viking satellite exploring the surface of Mars as it travels at low altitude through the spectacular 3,000-mile-long Valles Marineris canyon.

Though Broderbund didn't ship a book with this game, the company did make the Val 9000 database accessible directly from outside the program. Simply type "Carmen Val" at the DOS prompt, and you'll have access to all of Val 9000's knowledge.

If Where in Space is Carmen Sandiego? Deluxe is any example, we're all looking forward to the next generation of Carmen programs.

Where in Space is Carmen Sandiego? Deluxe, *$79.95.* Requires: *640K RAM, 8MB hard disk space, DOS 3.1 or later; sound card recommended. Broderbund Software Inc., 500 Redwood Blvd., P.O. Box 6121, Novato, CA 94948-6121; 415-382-4400, 800-521-6263; fax, 415-382-4582.*

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SIERRA ON-LINE

Lost Secret of the Rain Forest

When young Adam Greene and his ecologist dad arrive in Iquitos, Peru, to meet a representative of the Ecology Emergency Network, little does Adam know that he'll soon be journeying alone to the center of the rain forest, protecting its creatures, aiding the native Grove People, battling an evil human enemy, and helping the environment.

Such is the premise of Lost Secret of the Rain Forest, the second adventure in Sierra On-Line's Discovery Series. Designed for children ages ten and up, the game contains sufficient excitement, hidden clues, and action to keep avid gamers busy, while it reinforces the concept that our natural resources are worth more than gold.

DATA-STORING ECORDER

As with other Sierra games, players also use the program's Look and Talk buttons to gather facts; they place certain objects in inventory for future use. In this game, the storage device is an Ecorder, which Adam's dad gives him when they arrive. This gizmo resembles a television screen with a pistol grip and holds whatever key information the player acquires, such as facts about life

in the rain forest and problems with the ecology.

At the player's command, the Ecorder displays the stored information, pronounces the name of the object, and prints its entire database. The Ecorder will also use this information to prepare ten-question tests for players using the information they've gathered.

While Adam tries to help the rain forest's ecology, his adversary, Maxim Slaughter, searches for ancient gold treasures in the region. Slaughter is one mean dude who doesn't care about ecology or endangered species; his living quarters have a zebra-skin footlocker, a jaguar-skin rug, an ashtray made from a gorilla's hand, and bunny slippers made from real bunnies. Sometimes Slaughter captures Adam; the hero must then use all his skills and intelligence to escape. Many times, the objects Adam has collected during his travels help him escape perils or overcome obstacles.

Lost Secret of the Rain Forest runs under both DOS and Windows; it's filled with colorful screens, exciting action, and scenic detail. The animations, too, are noteworthy. On one screen, for example, Adam walks through the Grove People's village while women are cooking, a suitor courts his love, hunters talk, a boy plays a drum, and a woman cuts roots.

Sierra has included a users' guide that helps the player begin the game and use the Ecorder; a separate booklet summarizes major informational points in the program and offers suggestions for further study and family activities.

The game itself is challenging, and the clues are well-hidden. Sometimes, players may get stuck at a certain point in the game. If they can't discover the action they must perform to unlock the next sequence, they can get free hints from the Sierra electronic bulletin board, dial the 75-cent-per-minute 900 number for a clue, or buy the $9.95 hint book.

Lost Secret of the Rain Forest is a game with a purpose. Players see and hear about environmental misuse of the rain forest and learn how they can help to aid the environment. □

ECOLOGICALLY CORRECT: Using the Ecorder, players gather facts about the creatures of the rain forest.

Lost Secret of the Rain Forest, *$49.95.* Requires: *570K RAM, 8MB hard disk space, DOS 3.3 or later; mouse and sound card recommended. Sierra On-Line Inc., P.O. Box 485, Coarsegold, CA 93614; 800-326-6654, 209-683-4468; fax, 209-683-3633.*

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THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

John Jessen's Magic Camera

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—*United Airlines Hemisphere*

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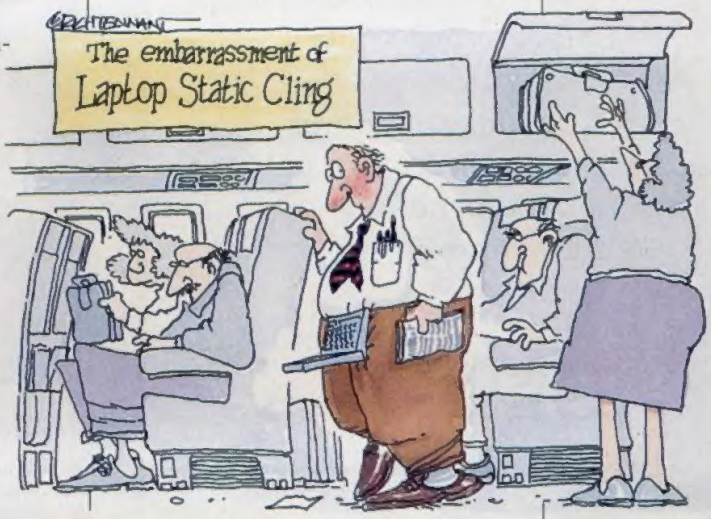

Richard Tennant

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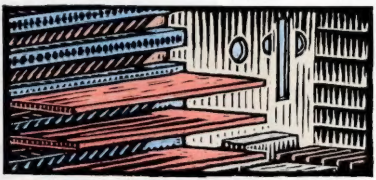

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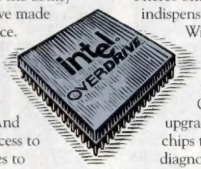

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